EMULATION TECHNOLOGY

LOGIC Emulation Source

User Guide
ET6000K10S

LOGIC EMULATION SOURCE

ET6000K10S User Manual Version 1.1

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Chapter 1

About This Manual

This User Guide accompanies the ET6000K10S LOGIC Emulation Board. For specific information regarding the Virtex-II Pro parts, please reference the datasheet.

1 Manual Contents

This manual contains the following chapters:

Chapter 1, "Getting Started", contains information on the contents of the LOGIC Emulation Kit.

Chapter 2, "Introduction to the Virtex-II and ISE", an overview of the Vitex-II platform and the software features.

Chapter 3, "Introduction to the Software Tools", information regarding test software.

Chapter 4, "Programming/Configuring the Hardware", step-by-step information on programming and configuring the hardware.

Chapter 5, "Board Hardware", detailed description of board hardware.

2 Additional Resources

For additional information, go to http://www.emulation.com. The following table lists some of the resources you can access from this website. You can also directly access these resources using the provided URLs.

Resource	Description/URL
User Manual	This is the main source of technical information. The manual should contain most of the answers to your questions

Resource	Description/URL
Web Site	The web page will contain the latest manual, application notes, FAQ, articles, and any device errata and manual addenda. Please visit and bookmark: http://www.emulation.com
Data Book	Pages from The Programmable Logic Data Book, which contains device-specific information on Xilinx device characteristics, including readback, boundary scan, configuration, length count, and debugging http://support.xilinx.com/partinfo/databook.htm
E-Mail	You may direct questions and feedback to Emulation Technology using this e-mail address: support@emulation.com
Phone Support	Call us at **408.982.0660** during the hours of 8:00am to 5:00pm Pacific Time.
FAQ	The download section of the web page contains a document called **ET6000K10S Frequently Asked Questions (FAQ)**. This document is periodically updated with information that may not be in the User's Manual.

3 Conventions

This document uses the following conventions. An example illustrates each convention.

3.1 Typographical

The following typographical conventions are used in this document:

Convention	Meaning or Use	Example
`Courier font`	Messages, prompts, and program files that the system displays	`speed grade: -100`
`Courier bold`	Literal commands that you enter in a syntactical statement	**`ngdbuild design_name`**
Garamond bold	Commands that you select from a menu	**File →Open**
	Keyboard shortcuts	**Ctrl+C**

Convention	Meaning or Use	Example
Italic font	Variables in a syntax statement for which you must supply values	ngdbuild *design_name*
	References to other manuals	See the *Development System Reference Guide* for more information.
	Emphasis in text	If a wire is drawn so that it overlaps the pin of a symbol, the two nets are *not* connected.
Braces [ ]	An optional entry or parameter. However, in bus specifications, such as bus[7:0], they are required.	ngdbuild [*option_name*] *design_name*
Braces { }	A list of items from which you must choose one or more	**lowpwr =**{**on**|**off**}
Vertical bar |	Separates items in a list of choices	**lowpwr =**{**on**|**off**}
Vertical ellipsis . . .	Repetitive material that has been omitted	IOB #1: Name = QOUT' IOB #2: Name = CLKIN' . .
Horizontal ellipsis . . .	Repetitive material that has been omitted	**allow block** *block_name* *loc1 loc2 ... locn;*
Prefix "0x" or suffix "h"	Indicates hexadecimal notation	Read from address 0x00110373, returned 4552494h
Letter "#" or "_n"	Signal is active low	INT# is active low fpga_inta_n is active low

3.2 Online Document

The following conventions are used in this document:

Convention	Meaning or Use	Example

Blue Text	Cross-reference link to a location in the current file or in another file in the current document	See the section "Additional Resources" for details. Refer to "Title Formats" in Chapter 1 for details.
Red Text	Cross-reference link to a location in another document	See Figure 2-5 in the *Virtex-II Handbook*
Blue, underlined text	Hyperlink to a website (URL)	Go to http://www.xilinx.com for the latest datasheets.

4 Relevant Information

Information about PCI can be obtained from the following sources:

Reference the PCI Special Interest Group for the latest in PCI/PCI-X Specifications:

PCI Special Interest Group http://www.pcisig.com

2575 NE Kathryn St. #17

Hillsboro, OR 97124

FAX: (503) 693-8344

Other recommended specifications include:

PCI Industrial Computer Manufacturers Group (PICMG) http://picmg.org

401 Edgewater Place, Suite 500

Wakefield, MA 01880, USA

TEL: 781-224-1100

FAX: 781-224-1239

Suggested reference books (available from Amazon):

Tom Shanley, Don Anderson, *PCI System Architecture (4th Edition),* Inc. Mindshare

Tom Shanley, Karen Gettman, *PCI-X System Architecture (With CD Edition),* Inc. Mindshare

Samir Palnitkar, *Verilog HDL: A Guide to Digital Design and Synthesis,* ISBN: 0-13-451675-3

Sundar Rajan, *Essential VHDL: RTL Synthesis Done Right*

Edwin Breecher, *The IQ Booster: Improve Your IQ Performance Dramatically*

Chapter

2

Getting Started

Congratulations on your purchase of the ET6000K10S LOGIC Emulation Board! You can begin by installing the software, or by powering on your ET6000K10S. If you wish to begin installation, please follow the installation instructions. The remainder of this chapter describes the contents of the box and how to start using the ET6000K10S LOGIC Emulation Board.

1 Precaution

The ET6000K10S is sensitive to static electricity, so treat the PCB accordingly. The target markets for this product are engineers that are familiar with FPGA's and circuit boards, so a lecture in ESD really isn't appropriate (and wouldn't be read anyway). However, the following web page has an excellent tutorial on the "Fundamentals of ESD" for those of you who are new to ESD sensitive products:

http://www.esda.org/basics/part1.cfm

The ET6000K10S has been factory tested and pre-programmed to ensure correct operation. You do not need to alter any jumpers or program anything to see the board work. A reference design is included on the enclosed CD. Please verify that the board is in working order by following the steps below:

2 The ET6000K10S LOGIC Emulation Kit

The ET6000K10S LOGIC Emulation Kit provides a complete development platform for designing and verifying applications based on the Xilinx Virtex-II Pro FPGA family. The ET6000K10S can be hosted in a 32/64-bit PCI/PCI-X slot, or can be used in a stand-alone application. This ET6000K10S enables designers to implement embedded processor based applications with extreme flexibility using IP cores and

customized modules. The Virtex-II Pro FPGA with its integrated PowerPC processor and powerful Rocket I/O. Multi-Gigabit Transceivers (MGT) make it possible to develop highly flexible and high-speed serial transceiver applications.

The ET6000K10S, in its standard configuration, includes 64-bit PCI/PCI-X interface, 512K x 36 SRAM (4), 16M x 16 DDR SDRAM (4), 4M x 16 FLASH (2), an RS232 port for monitor and a SmartMedia interface for configuration. There are 9 low skew clock sources that are distributed to the FPGA and the test header. A 200-pin test header allows for connection to individual FPGA's IO banks, using a custom daughter card.

Figure 1 - shows the ET6000K10S Logic Emulation Board

Figure 1 - ET6000K10S LOGIC Emulation Board

The ET6000K10S LOGIC Emulation Kit includes the following:

- ✓ ET6000K10S development board (2VP70 or 2VP100 in the FF1704 package) Note: Specific speed grade parts required for various RocketIO/Power PC operating speeds, refer to Xilinx datasheet.
- ✓ 32MB SmartMedia Card, with reference design and main.txt
- ✓ 32MB SmartMedia Card, for customer use (blank)
- ✓ FlashPath Adapter to copy bit files to the SmartMedia Card(s)
- ✓ RS232 Serial cable, female to female (6ft)

- ✓ IDC 10-pin to DB 9-pin adaptor cable
- ✓ Jumpers 0.1"(x10)
- ✓ Documentation/Reference CD

Optional items that support development efforts (not provided):

- ✓ Xilinx ISE software
- ✓ JTAG cable
- ✓ Coax loop back cables
- ✓ Daughter Card
- ✓ ATAVRISP kit (for MCU reprogramming)

3 Installation Instructions

3.1 Jumper Setup

Figure 2 indicates the factory jumper configuration of the ET6000K10S.

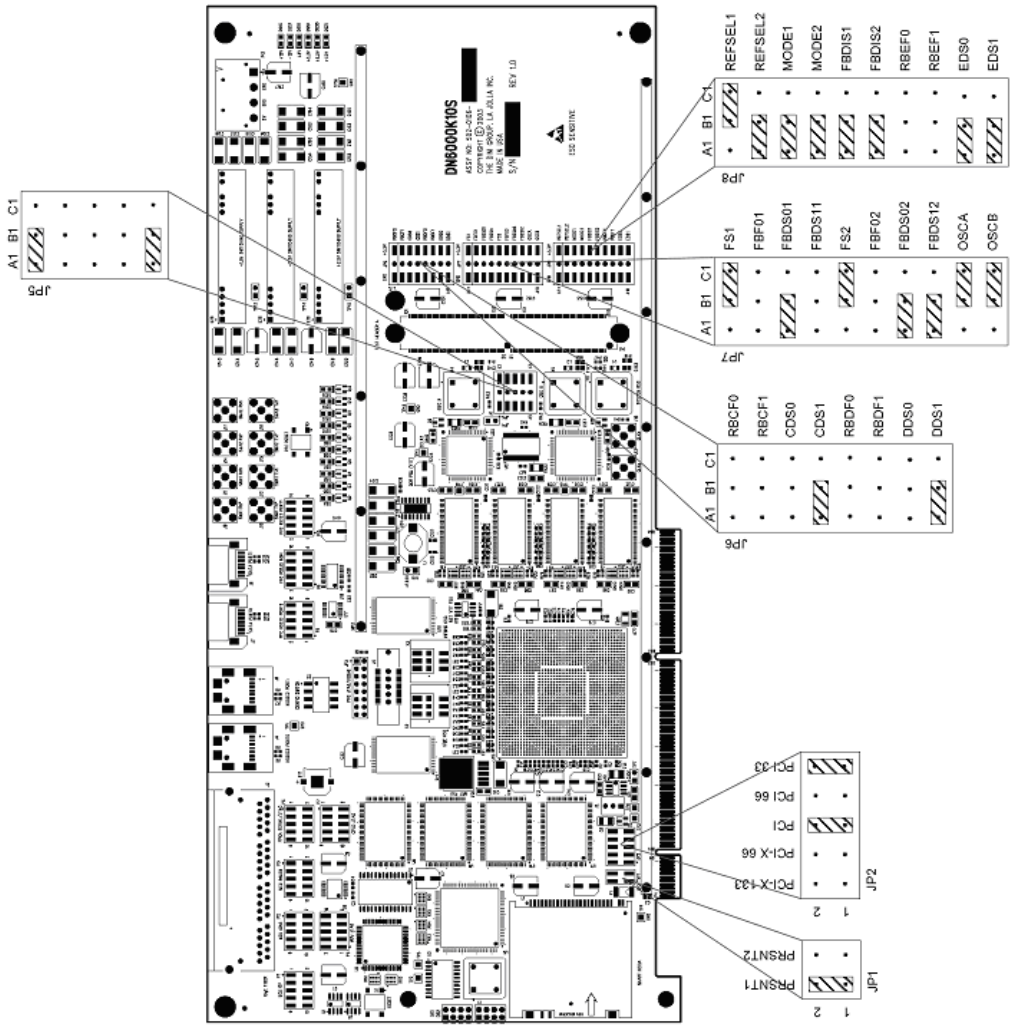


Figure 2 - Default Jumper Setup

3.2 Jumper Description

Table 1 – describes the functionality of the installed jumpers on the ET6000K10S.

Table 1 – Jumper Description

Jumper Installed	Signal Name	Description
JP1.1-2	PRSNT1	Configured for 25W power setting
JP2.1-2 JP2.7-8	PCIXCAP PCI_M66EN	PCI interface configured for conventional PCI at 33MHz

Jumper Installed	Signal Name	Description
JP5.A1-B1	CLOCKA	Oscillator (X4) connected to RoboClock #2 (U26)
JP5.A1-B1	CLOCKB	Oscillator (X5) connected to RoboClock #1 (U25)
JP6.A3-B3	CDS0	ROBOCLOCK #1, Output Divider Function Select: Controls the divider function of bank 3 & 4 (CCLK) of outputs. Refer to Table 4 in the datasheet.
JP6.A4-B4	CDS1	ROBOCLOCK #1, Output Divider Function Select: Controls the divider function of bank 3 & 4 (CCLK) of outputs. Refer to Table 4 in the datasheet.
JP6.A7-B7	DDS0	ROBOCLOCK #1, Output Divider Function Select: Controls the divider function of bank 1 & 1 (DCLK) of outputs. Refer to Table 4 in the datasheet.
JP6.A7-B8	DDS1	ROBOCLOCK #1, Output Divider Function Select: Controls the divider function of bank 1 & 1 (DCLK) of outputs. Refer to Table 4 in the datasheet.
JP7.A1-B1	FS1	ROBOCLOCK #1, Frequency Select: This input must be set according to the nominal frequency (fNOM). Refer to Table 1 in the datasheet.
JP7.A4-B4	FBDS11	ROBOCLOCK #1, Feedback Divider Function Select: These inputs determine the function of the QFA0 and QFA1 outputs. Refer to Table 4 in the datasheet.
JP7.B5-C5	FS2	ROBOCLOCK #2, Frequency Select: This input must be set according to the nominal frequency (fNOM). Refer to Table 1 in the datasheet.
JP7.A7-B7	FBDS02	ROBOCLOCK #2, Feedback Divider Function Select: These inputs determine the function of the QFA0 and QFA1 outputs. Refer to Table 4 in the datasheet.
JP7.A9-B9	OSCA	Enable for Oscillator A (X4)
JP7.A10-B10	OSCB	Enable for Oscillator B (X5)
JP8.A1-B1	REFSEL1	ROBOCLOCK #1, Reference Select Input: The REFSEL input controls how the reference input is configured. When LOW, it will use the REFA pair (PLL1A) as the reference input. When HIGH, it will use the REFB pair (PLL1BC, PLL1BNC) as the reference input. This input has an internal pull-down.

Jumper Installed	Signal Name	Description
JP8.A2-B2	REFSEL2	ROBOCLOCK #2, Reference Select Input: The REFSEL input controls how the reference input is configured. When LOW, it will use the REFA pair (DCLK3 or FPGA_CLKOUT) as the reference input. When HIGH, it will use the REFB pair (PLL2BC or PLL2BNC) as the reference input. This input has an internal pull-down.
JP8.A3-B3	MODE1	ROBOCLOCK #1, Output Mode: This pin determines the clock outputs' disable state. When this input is HIGH, the clock outputs will disable to high-impedance (HI-Z). When this input is LOW, the clock outputs will disable to "HOLD-OFF" mode. When in MID, the device will enter factory test mode.
JP8.A4-B4	MODE2	ROBOCLOCK #2, Output Mode: This pin determines the clock outputs' disable state. When this input is HIGH, the clock outputs will disable to high-impedance (HI-Z). When this input is LOW, the clock outputs will disable to "HOLD-OFF" mode. When in MID, the device will enter factory test mode.
JP8.A9-B9	EDS0	ROBOCLOCK #2, Output Divider Function Select: Controls the divider function of bank 1, 2, 3 & 4 (ECLK) of outputs. Refer to Table 4 in the datasheet.
JP8.A10-B10	EDS1	ROBOCLOCK #2, Output Divider Function Select: Controls the divider function of bank 1, 2, 3 & 4 (ECLK) of outputs. Refer to Table 4 in the datasheet.

3.3 Powering ON the ET6000K10S

This section describes what is necessary to power-up the ET6000K10S.

1. Install the ET6000K10S in the test PC.

Note: The PCI interface is keyed so that it is not possible to mistakenly plug the board into a +5V PCI slot. Do **NOT** grind out the key in the PCI host slot, and do **NOT** modify the ET6000K10S to get it to fit into the slot. Emulation Technology offers a PCI Extender P/N ETPCIEXT-S3 that can be used to interface the ET6000K10S to the PC in case no +3.3V slots are available. Please refer to Emulation Technology website for more information.

2. Install the SmartMedia card containing the PCI reference design into the ET6000K10S.

3. Power ON the test PC and allow booting in DOS mode.

Note: The FPGA programming will commence as soon as the ET6000K10S is powered on if the SmartMedia card contains the necessary configuration file and bit files. In general, the FPGA will be programmed prior to the PCI devices being configured. However, some computers have a "FastBoot" or "QuickBoot" feature which speeds up the booting process of the PC. These features are incompatible with the FPGA programming sequence of the ET6000K10S as the FPGA may not be configured prior to PCI bus activity. As a result, the ET6000K10S will not be recognized by the computer.

Workaround: If the computer has a "FastBoot" or "QuickBoot" (or similar) feature, it should be disabled. Otherwise, a soft-reset should be performed (by simultaneously pressing the CTRL-ALT-DELETE keys) after the computer has completed the Power-On Self Test (POST). This will allow the ET6000K10S enough time to configure the FPGA so that the computer will recognize the ET6000K10S device.

4 Playing with your ET6000K10S

At this point, the ET6000K10S should be powered on with the PC booted in DOS mode. The FPGA should also be programmed with the PCI reference design supplied by Emulation Technology. The ASIC Emulator Test Utility (AETEST) can now be used in DOS to verify the functionality of the ET6000K10S.

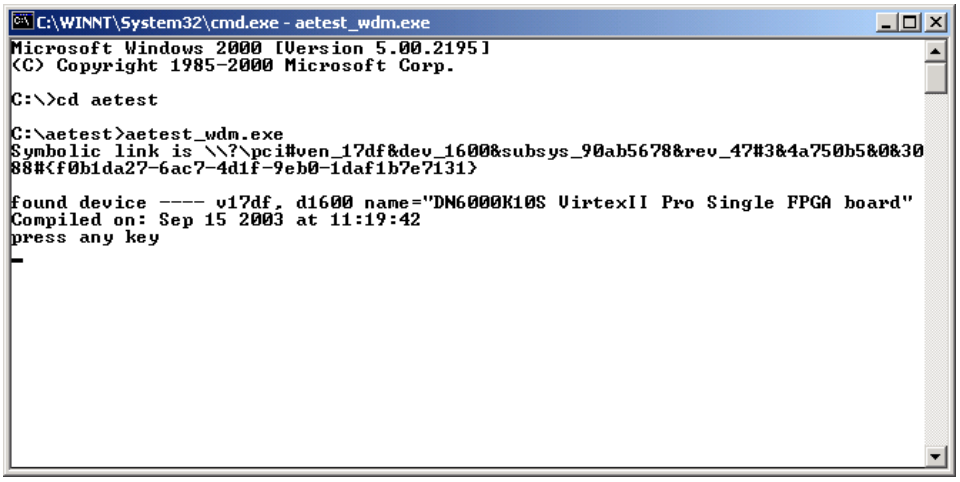
1. If the AETEST utility is not yet installed, refer to Appendix A for installation instructions.

2. Run the AETEST utility appropriate for the Operating System.

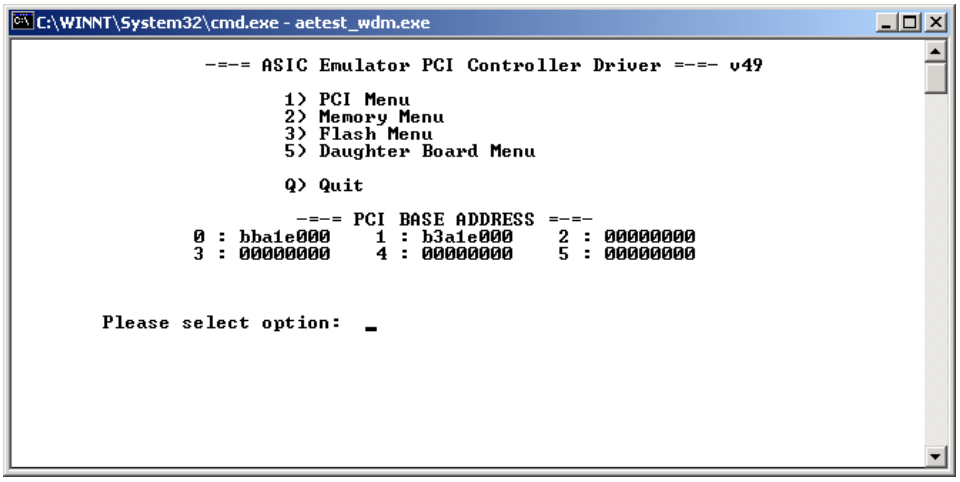
   - "AETESTDJ.EXE" for Windows 95/98/ME using DPMI
   - "AETEST98.EXE" for Windows 98/ME using VxD driver

- "AETEST_WDM.EXE" for Windows 2000/XP

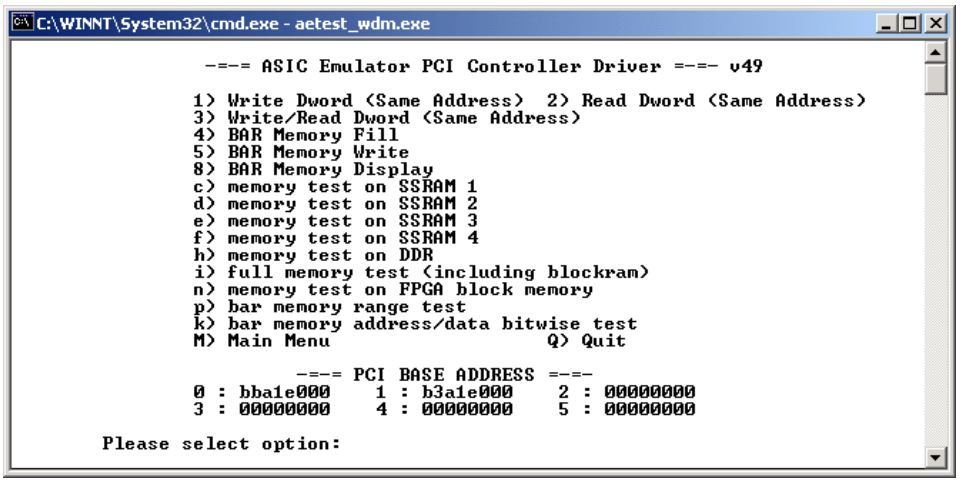
3. The AETEST utility should now recognize the ET6000K10S with the DEVICE_ID of 0x1600 and its VENDOR_ID of 0x17DF.


C:\WINNT\System32\cmd.exe - aetest_wdm.exe
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.
C:\>cd aetest
C:\aetest>aetest_wdm.exe
Symbolic link is \\?\pci#ven_17df&dev_1600&subsys_90ab5678&rev_47#3&4a750b5&0&3088#{f0b1da27-6ac7-4d1f-9eb0-1daf1b7e7131}
found device ---- v17df, d1600 name="DN6000K10S VirtexII Pro Single FPGA board"
Compiled on: Sep 15 2003 at 11:19:42
press any key

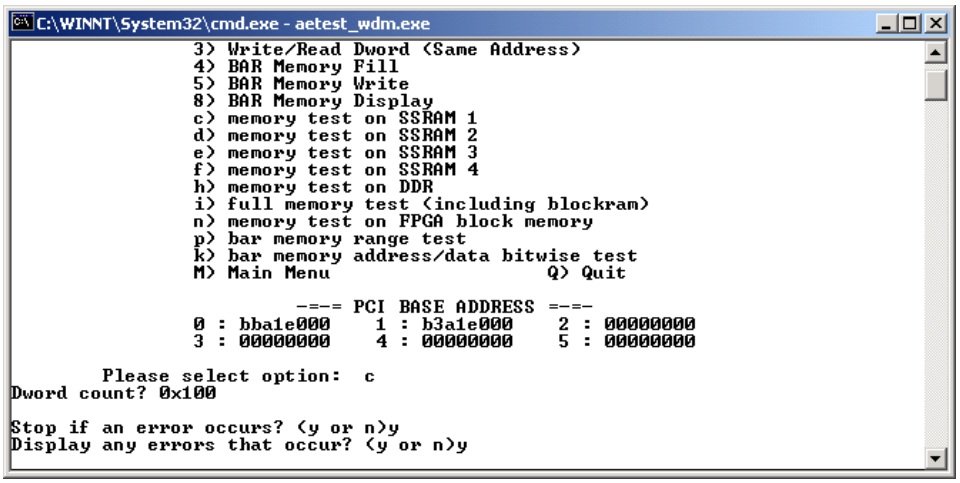
4. Follow the on-screen instructions until the Main Menu is displayed.


C:\WINNT\System32\cmd.exe - aetest_wdm.exe
--=- ASIC Emulator PCI Controller Driver =-=- v49
1) PCI Menu
2) Memory Menu
3) Flash Menu
5) Daughter Board Menu
Q) Quit
-=-= PCI BASE ADDRESS =-=-
0 : bba1e000 1 : b3a1e000 2 : 00000000
3 : 00000000 4 : 00000000 5 : 00000000
Please select option:

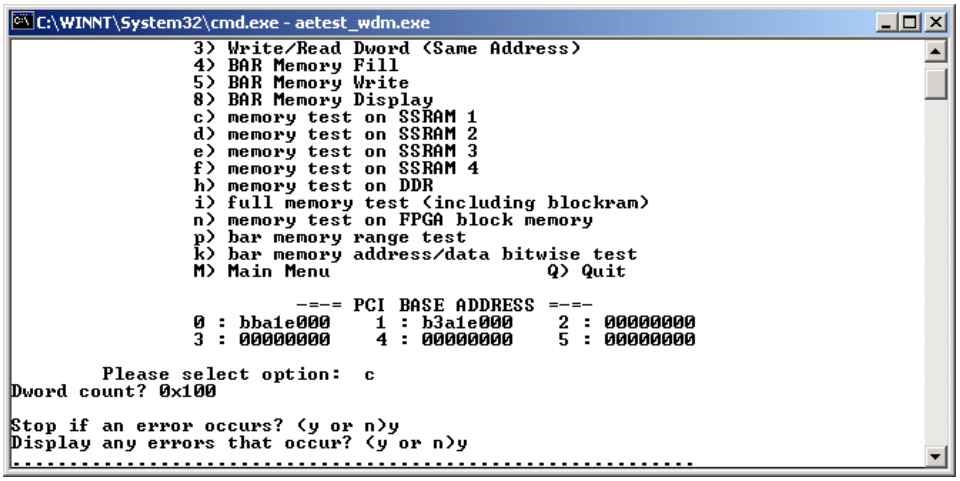
5. From the Main Menu, choose "Memory Menu". The memory menu will now appear.


C:\WINNT\System32\cmd.exe - aetest_wdm.exe
--=-= ASIC Emulator PCI Controller Driver =-=-- v49
1) Write Dword (Same Address) 2) Read Dword (Same Address)
3) Write/Read Dword (Same Address)
4) BAR Memory Fill
5) BAR Memory Write
8) BAR Memory Display
c) memory test on SSRAM 1
d) memory test on SSRAM 2
e) memory test on SSRAM 3
f) memory test on SSRAM 4
h) memory test on DDR
i) full memory test (including blockram)
n) memory test on FPGA block memory
p) bar memory range test
k) bar memory address/data bitwise test
M) Main Menu Q) Quit
-=-= PCI BASE ADDRESS =-=-
0 : bba1e000 1 : b3a1e000 2 : 00000000
3 : 00000000 4 : 00000000 5 : 00000000
Please select option:

6. The ET6000K10S features DDR SDRAM, SRAM, and Flash memory devices. The ET6000K10S specific memory tests are designed to exercise and verify the functionality of those features. Select one of the memory devices to be tested.


C:\WINNT\System32\cmd.exe - aetest_wdm.exe
3) Write/Read Dword (Same Address)
4) BAR Memory Fill
5) BAR Memory Write
8) BAR Memory Display
c) memory test on SSRAM 1
d) memory test on SSRAM 2
e) memory test on SSRAM 3
f) memory test on SSRAM 4
h) memory test on DDR
i) full memory test (including blockram)
n) memory test on FPGA block memory
p) bar memory range test
k) bar memory address/data bitwise test
M) Main Menu Q) Quit
-=-= PCI BASE ADDRESS =-=-
0 : bba1e000 1 : b3a1e000 2 : 00000000
3 : 00000000 4 : 00000000 5 : 00000000
Please select option: c
Dword count? 0x100
Stop if an error occurs? (y or n)y
Display any errors that occur? (y or n)y

7. The AETEST Test utility will now test the selected memory device using the memory controllers available in the PCI reference design. Press any key to exit the selected memory device test. The test should complete successfully, as indicated by the dots.


C:\WINNT\System32\cmd.exe - aetest_wdm.exe
3) Write/Read Dword (Same Address)
4) BAR Memory Fill
5) BAR Memory Write
8) BAR Memory Display
c) memory test on SSRAM 1
d) memory test on SSRAM 2
e) memory test on SSRAM 3
f) memory test on SSRAM 4
h) memory test on DDR
i) full memory test (including blockram)
n) memory test on FPGA block memory
p) bar memory range test
k) bar memory address/data bitwise test
M) Main Menu
Q) Quit
-=-= PCI BASE ADDRESS =-=-
0 : bba1e000
1 : b3a1e000
2 : 00000000
3 : 00000000
4 : 00000000
5 : 00000000
Please select option: c
Dword count? 0x100
Stop if an error occurs? (y or n)y
Display any errors that occur? (y or n)y

8. Congratulations! You have now programmed the ET6000K10S and successfully executed our AETEST utility to exercise various features of the ET6000K10S.

Chapter 3

Introduction to Virtex-II Pro and ISE

1 Virtex-II Pro

The Virtex-II Pro FPGA solution is the most technically sophisticated silicon and software product development in the history of the programmable logic industry. The goal was to revolutionize system architecture "from the ground up." To achieve that objective, the best circuit engineers and system architects from IBM, Mindspeed, and Xilinx co developed the world's most advanced FPGA silicon product. Leading teams from top embedded systems companies worked together with Xilinx software teams to develop the systems software and IP solutions that enabled new system architecture paradigm.

The result is the first FPGA solution capable of implementing high performance system-on-a-chip designs previously the exclusive domain of custom ASICs, yet with the flexibility and low development cost of programmable logic. The Virtex-II Pro family marks the first paradigm change from programmable logic to programmable systems, with profound implications for leading-edge system architectures in networking applications, deeply embedded systems, and digital signal processing systems. It allows custom user-defined system architectures to be synthesized, next-generation connectivity standards to be seamlessly bridged, and complex hardware and software systems to be co-developed rapidly with in-system debug at system speeds. Together, these capabilities usher in the next programmable logic revolution.

1.1 Summary of Virtex-II Pro Features

The Virtex-II Pro has an impressive collection of both programmable logic and hard IP that has historically been the domain of the ASICs.

- High-performance FPGA solution including:
  - Up to twenty-four RocketIO™ embedded multi-gigabit transceiver blocks (based on Mindspeed's SkyRail™ technology)

  - Up to four IBM® PowerPC™ RISC processor blocks
- Based on Virtex™-II FPGA technology
  - Flexible logic resources, up to 125,136 Logic Cells
  - SRAM-based in-system configuration
  - Active Interconnect™ technology
  - SelectRAM™ memory hierarchy
  - Up to 556 Dedicated 18-bit x 18-bit multiplier blocks
  - High-performance clock management circuitry
  - SelectIO™-Ultra technology
  - Digitally Controlled Impedance (DCI) I/O

1.2 PowerPC™ 405 Core

- Embedded 300+ MHz Harvard architecture core
- Low power consumption: 0.9 mW/MHz
- Five-stage data path pipeline
- Hardware multiply/divide unit
- Thirty-two 32-bit general purpose registers
- 16 KB two-way set-associative instruction cache
- 16 KB two-way set-associative data cache
- Memory Management Unit (MMU)
  - 64-entry unified Translation Look-aside Buffers (TLB)
  - Variable page sizes (1 KB to 16 MB)
- Dedicated on-chip memory (OCM) interface
- Supports IBM CoreConnect™ bus architecture
- Debug and trace support
- Timer facilities

1.3 RocketIO 3.125 Gbps Transceivers

- Full-duplex serial transceiver (SERDES) capable of baud rates from 622 Mb/s to 3.125 Gb/s (please reference the Xilinx datasheet for speed grade limitations)
- 80 Gb/s duplex data rate (16 channels)

- Monolithic clock synthesis and clock recovery (CDR)
- Fibre Channel, Gigabit Ethernet, 10 Gb Attachment Unit Interface (XAUI), and
- Infiniband-compliant transceivers
- 8-, 16-, or 32-bit selectable internal FPGA interface
- 8B /10B encoder and decoder
- 50/75 on-chip selectable transmit and receive terminations
- Programmable comma detection
- Channel bonding support (two to sixteen channels)
- Rate matching via insertion/deletion characters
- Four levels of selectable pre-emphasis
- Five levels of output differential voltage
- Per-channel internal loopback modes
- 2.5V transceiver supply voltage

1.4 Virtex-II FPGA Fabric

Description of the Virtex-II Family fabric follows:

- SelectRAM memory hierarchy
  - Up to 10 Mb of True Dual-Port RAM in 18 Kb block SelectRAM resources
  - Up to 1.7 Mb of distributed SelectRAM resources
  - High-performance interfaces to external memory
- Arithmetic functions
  - Dedicated 18-bit x 18-bit multiplier blocks
  - Fast look-ahead carry logic chains
- Flexible logic resources
  - Up to 111,232 internal registers/latches with Clock Enable
  - Up to 111,232 look-up tables (LUTs) or cascadable variable (1 to 16 bits) shift registers
  - Wide multiplexers and wide-input function support
  - Horizontal cascade chain and Sum-of-Products support

  - Internal 3-state busing
- High-performance clock management circuitry
  - Up to eight Digital Clock Manager (DCM) modules
    - Precise clock de-skew
    - Flexible frequency synthesis
    - High-resolution phase shifting
  - 16 global clock multiplexer buffers in all parts
- Active Interconnect technology
  - Fourth-generation segmented routing structure
  - Fast, predictable routing delay, independent of fanout
  - Deep sub-micron noise immunity benefits
- Select I/O-Ultra technology
  - Up to 852 user I/Os
  - Twenty two single-ended standards and five differential standards
  - Programmable LVTTL and LVCMOS sink/source current (2 mA to 24 mA) per I/O
  - Digitally Controlled Impedance (DCI) I/O: on-chip termination resistors for single-ended I/O standards
  - PCI support(1)
  - Differential signaling
    - 840 Mb/s Low-Voltage Differential Signaling I/O (LVDS) with current mode drivers
    - Bus LVDS I/O
    - HyperTransport™ (LDT) I/O with current driver buffers
    - Built-in DDR input and output registers
  - Proprietary high-performance SelectLink technology for communications between Xilinx devices
    - High-bandwidth data path
    - Double Data Rate (DDR) link
    - Web-based HDL generation methodology
- SRAM-based in-system configuration
  - Fast SelectMAP™ configuration

  - Triple Data Encryption Standard (DES) security option (bitstream encryption)
  - IEEE1532 support
  - Partial reconfiguration
  - Unlimited reprogrammability
  - Readback capability
- Supported by Xilinx Foundation™ and Alliance™ series development systems
  - Integrated VHDL and Verilog design flows
  - ChipScope™ Pro Integrated Logic Analyzer
- 0.13-µm, nine-layer copper process with 90 nm high-speed transistors
- 1.5V (VCCINT) core power supply, dedicated 2.5V VCCAUX auxiliary and VCCO power supplies
- IEEE 1149.1 compatible boundary-scan logic support
- Flip-Chip and Wire-Bond Ball Grid Array (BGA) packages in standard 1.00 mm pitch
- Each device 100% factory tested

2 Foundation ISE 6.1i

ISE Foundation is the industry's most complete programmable logic design environment. ISE Foundation includes the industry's most advanced timing driven implementation tools available for programmable logic design, along with design entry, synthesis and verification capabilities. With its ultra-fast runtimes, ProActive Timing Closure technologies, and seamless integration with the industry's most advanced verification products, ISE Foundation offers a great design environment for anyone looking for a complete programmable logic design solution.

2.1 Foundation Features

2.1.1 Design Entry

ISE greatly improves your "Time-to-Market", productivity, and design quality with robust design entry features. ISE provides support for today's most popular methods for design capture including HDL and schematic entry, integration of IP cores as well as robust support for reuse of your own IP. ISE even includes technology called IP Builder, which allows you to capture your own IP and reuse it in other designs.

ISE's Architecture Wizards allow easy access to device features like the Digital Clock Manager and Multi-Gigabit I/O technology. ISE also includes a tool called PACE (Pinout Area Constraint Editor), which includes a front-end pin assignment editor, a

design hierarchy browser, and an area constraint editor. By using PACE, designers are able to observe and describe information regarding the connectivity and resource requirements of a design, resource layout of a target FPGA, and the mapping of the design onto the FPGA via location/area.

This rich mixture of design entry capabilities provides the easiest to use design environment available today for your logic design.

2.1.2 Synthesis

Synthesis is one of the most essential steps in your design methodology. It takes your conceptual Hardware Description Language (HDL) design definition and generates the logical or physical representation for the targeted silicon device. A state of the art synthesis engine is required to produce highly optimized results with a fast compile and turnaround time. To meet this requirement, the synthesis engine needs to be tightly integrated with the physical implementation tool and have the ability to proactively meet the design timing requirements by driving the placement in the physical device. In addition, cross probing between the physical design report and the HDL design code will further enhance the turnaround time.

Xilinx ISE provides the seamless integration with the leading synthesis engines from Mentor Graphics, Synopsys, and Synplicity. You can use the synthesis engine of our choice. In addition, ISE includes Xilinx proprietary synthesis technology, XST. You have options to use multiple synthesis engines to obtain the best-optimized result of your programmable logic design.

2.1.3 Implementation and Configuration

Programmable logic design implementation assigns the logic created during design entry and synthesis into specific physical resources of the target device.

The term "place and route" has historically been used to describe the implementation process for FPGA devices and "fitting" has been used for CPLDs. Implementation is followed by device configuration, where a bitstream is generated from the physical place and route information and downloaded into the target programmable logic device.

To ensure designers get their product to market quickly, Xilinx ISE software provides several key technologies required for design implementation:

- Ultra-fast runtimes enable multiple "turns" per day
- ProActive™ Timing Closure drives high-performance results
- Timing-driven place and route combined with "push-button" ease
- Incremental Design

- Macro Builder

2.1.4 Board Level Integration

Xilinx understands the critical issues such as complex board layout, signal integrity, high speed bus interface, high-performance I/O bandwidth, and electromagnetic interference for system level designers.

To ease the system level designers' challenge, ISE provides support to all Xilinx leading FPGA technologies:

- System IO
- XCITE
- Digital clock management for system timing
- EMI control management for electromagnetic interference

To really help you ensure your programmable logic design works in context of your entire system, Xilinx provides complete pin configurations, packaging information, tips on signal integration, and various simulation models for your board level verification including:

- IBIS models
- HSPICE models
- STAMP models

3 Virtex-II Pro Developer's Kit

V2PDK is the Virtex-II Pro Developer's Kit, and is included to provide an existing framework of hardware and software code to explore the capabilities of the Virtex-II Pro, as well as a basis to build new systems.

A wide variety of software and hardware tools are used to build a Virtex-II Pro™ design. V2PDK The design flow is a tool chain methodology that exists to simplify the entire design process by providing integration between the tools and automating tasks. The main focus of the design flow is integrating the programs with each other to accomplish the system design.

The system design process can be loosely divided into the following tasks:

- Builds the software application

- Simulates the hardware description
- Simulates the hardware with the software application
- Simulates the hardware into the FPGA using the software application in on-chip memory
- Runs timing simulation
- Configures the bitstream for the FPGA

Chapter 4

Introduction to the Software Tools

This chapter introduces the software tools as well as references to more information.

1 Exploring the Software Tools

1.1 AETEST

AETEST utility program is used primarily to test and verify the functionality of the ET6000K10S Logic Emulation board.

All AETEST source code is included on the CD-ROM shipped with your ET6000K10S Logic Emulation kit. AETEST can be installed on a variety of operating systems, including:

- DOS and Windows 95/98/ME using DPMI (DOS Protected Mode Interface)
- Windows 98/ME using a VxD driver
- Windows 2000/XP (Windows WDM)
- Windows NT
- Linux
- Solaris

Detailed installation instructions for each version may be found in Appendix

Appendix A: AETEST Installation Instructions.

The AETEST utility program contains the following tests:

- PCI Test
- Memory Tests (SRAM & DDR)
- FLASH Test
- Daughter Card Test (with or without cables)
- BAR Memory Range Tests

AETEST also provides the user with the following abilities:

- Recognize the ET6000K10S
- Read FPGA F Revision
- Display Vendor and Device ID
- Set PCI Device and Function Number
- Display all configured PCI devices
- Various loops for PCI device-function and ID numbers
- Write and Read Configuration DWORD
- Write DWORD, Read DWORD and Write/Read DWORD (Same Address)
- BAR Memory Fill, Write and Display
- Configure/Save BAR's from/to a file

All of AETEST's tests and functionality are based upon simple C++ functions. Descriptions of a variety of functions may be found in

Appendix B: AETEST Basic C++ Functions.

NOTE: All of the screen captures are taken from the **aetest_wdm.exe** implementation of the AETEST utility program unless otherwise noted. Certain functions may be missing from the figures. However, all functions will be discussed in their proper context.

1.1.1 Getting Started with AETEST

Once AETEST is installed and the ET6000K10S board is powered on, the user can execute his/her incarnation of AETEST. The ET6000K10S is defined by its **DEVICE_ID** of **0x1600** and its **VENDOR_ID** of **0x17df**. AETEST should immediately recognize the ET6000K10S Logic Emulation board shown in Figure 3.

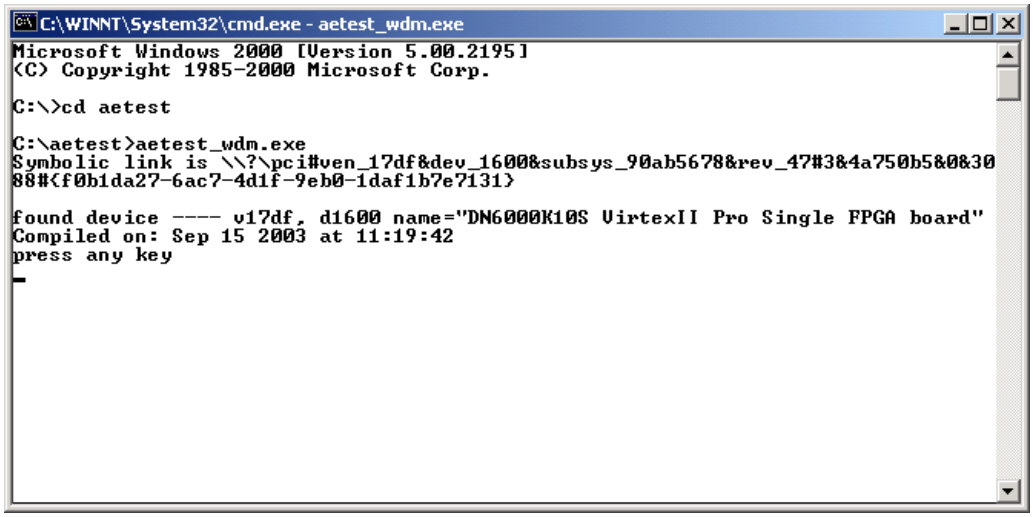

C:\WINNT\System32\cmd.exe - aetest_wdm.exe
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.
C:\>cd aetest
C:\aetest>aetest_wdm.exe
Symbolic link is \\?\pci#ven_17df&dev_1600&subsys_90ab5678&rev_47#3&4a750b58&0&3088#{f0b1da27-6ac7-4d1f-9eb0-1daf1b7e7131}
found device ---- v17df, d1600 name="DN6000K10S VirtexII Pro Single FPGA board"
Compiled on: Sep 15 2003 at 11:19:42
press any key

Figure 3 - ET6000K10S Board Recognition

Upon recognition, AETEST will notify the user which device was found. In certain implementations, the entire configuration space and the configuration of the BARs is sent to the screen immediate following the board recognition notification.

If AETEST does not recognize the ET6000K10S, AETEST will alert the user (See Figure 4).

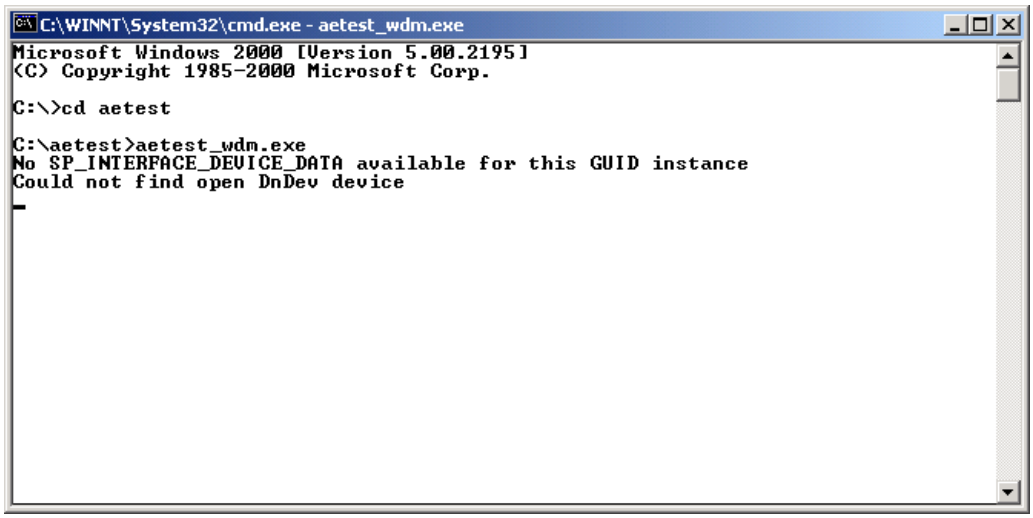

C:\WINNT\System32\cmd.exe - aetest_wdm.exe
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.
C:\>cd aetest
C:\aetest>aetest_wdm.exe
No SP_INTERFACE_DEVICE_DATA available for this GUID instance
Could not find open DnDev device

Figure 4 - ET6000K10S Not Found

AETEST will still run however several ET6000K10S specific options will not be available.

1.1.2 Main Menu

Upon powering up and after board recognition, the user must merely press a key to enter the Main Menu shown in Figure 5.

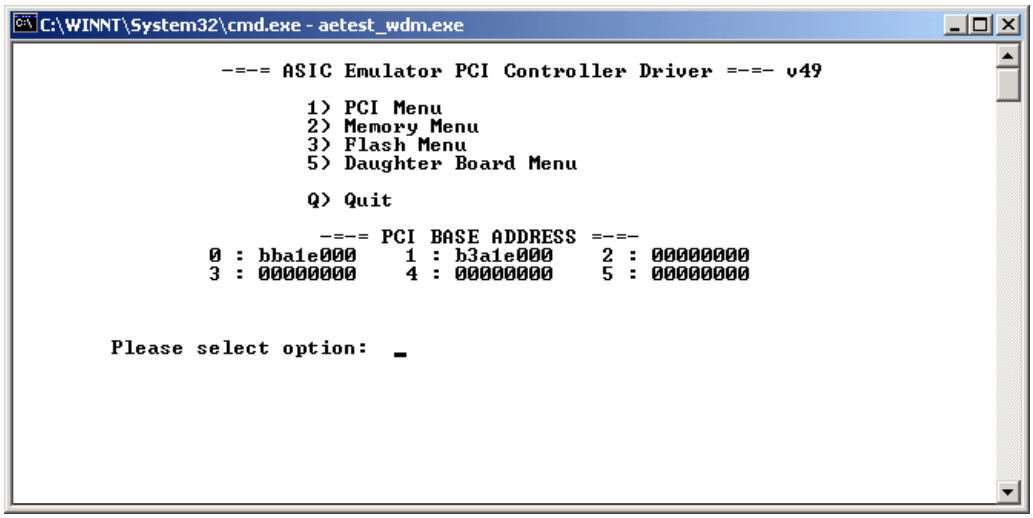

C:\WINNT\System32\cmd.exe - aetest_wdm.exe
-=-= ASIC Emulator PCI Controller Driver =-=- v49
1) PCI Menu
2) Memory Menu
3) Flash Menu
5) Daughter Board Menu
Q) Quit
-=-= PCI BASE ADDRESS =-=-
0 : bba1e000 1 : b3a1e000 2 : 00000000
3 : 00000000 4 : 00000000 5 : 00000000
Please select option:

Figure 5 - Main Menu

The possible Main Menu options and a description can be found in Table 2.

Table 2: Main Menu Options

Option	Function Name	Description
0	Read FPGA F Revision	Displays the revision of the reference design in FPGA F
1	PCI Menu	Takes User to PCI Menu
2	Memory Menu	Takes User to Memory Menu
5	Daughter Board Menu	Take User to Daughter Board Menu

1.1.3 PCI Menu

Upon entering the PCI Menu from the Main Menu, AETEST will output a screen similar to the one shown in Figure 6.

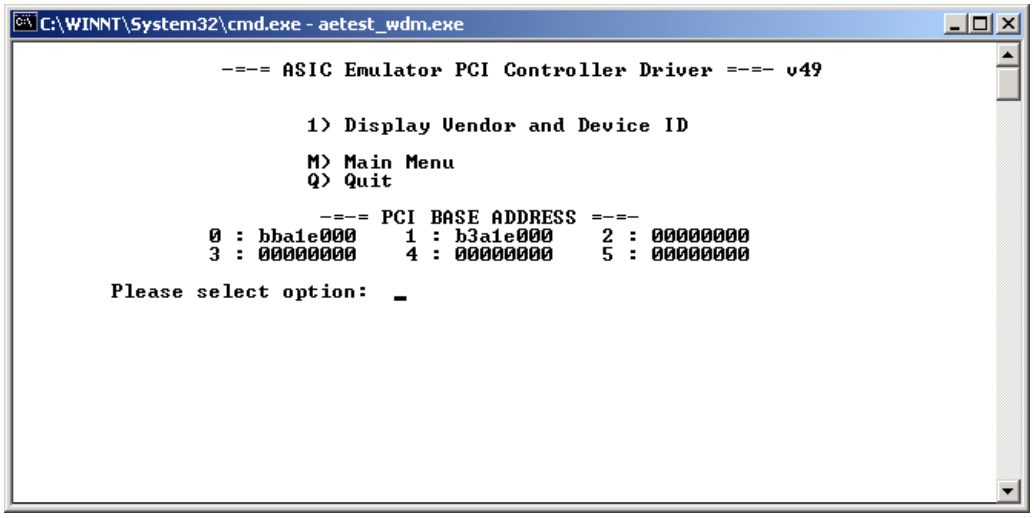

C:\WINNT\System32\cmd.exe - aetest_wdm.exe
-=-= ASIC Emulator PCI Controller Driver =-=- v49
1> Display Vendor and Device ID
M> Main Menu
Q> Quit
-=-= PCI BASE ADDRESS =-=-
0 : bba1e000 1 : b3a1e000 2 : 00000000
3 : 00000000 4 : 00000000 5 : 00000000
Please select option:

Figure 6 - PCI Menu

The possible PCI Menu options and a description can be found in Table 3.

Table 3 - PCI Menu Options

Option	Function Name	Description
S	Set PCI Device Number	Sets a PCI device number of your choice as the "active" device (hex input). Available device numbers is listed to help the user match up the Device ID and Vendor ID with the desired device number.

Option	Function Name	Description
F	Set PCI Function Number	Sets a PCI function number of your choice as the "active" function of a multi-function device (hex input). The Device ID and Vendor ID of each function within the "active device number to help the user choose the desired function.
D	Display all configured PCI devices	Displays the PCI device numbers and corresponding Device ID and Vendor ID of all devices seen on the bus. This function will not display device numbers with a Device ID and Vendor ID of all one (0xFFFF).
1	Display Vendor and Device ID	Displays the Vendor ID and the Device ID for the ET6000K10S, which should be 0x17df and 0x1600 respectively.
2	Display Vendor and Device ID for PCI device-function	Displays the Vendor ID and Device ID of the active device and function number.
3	Loop on PCI device-function: 7F-0 and display Vendor and Device ID	Reads and displays the Vendor ID and Device ID of the "active" device number and function number. Repeats until the user presses a key to stop it.
4	Loop on PCI device-function: 7F-0 and without displaying Vendor and Device ID	Reads the Vendor ID and Device ID of the "active" device number and function number without displaying them. This function is useful when the user is debugging configuration accesses.
5	Progressive loop on all PCI device numbers with display Vendor and Device ID	Loops on device number 0, reading the Vendor ID and Device ID. The function moves onto the next device number (1) when the user presses a key. The function moves all the way through device number 0 to device number 0x7F (in case there are any bridges on your PCI bus).
5	Display all PCI information for PCI device-function: 7F-0	Reads and displays all of the configuration space for the "active" device and function number. Use options 'S' and 'F' to change the "active" device and function numbers respectively. Then, use this option to view the entire configuration space.

Option	Function Name	Description
6	Write Config DWORD	Allows the user to write to configuration space. The following text will appear to remind the user what is in configuration space for a PCI device: PCI_CS_VENDOR_ID 0x00 PCI_CS_DEVICE_ID 0x02 PCI_CS_COMMAND 0x04 PCI_CS_STATUS 0x06 PCI_CS_REVISION_ID 0x08 PCI_CS_CLASS_CODE 0x09 PCI_CS_CACHE_LINE_SIZE 0x0c PCI_CS_MASTER_LATENCY 0x0d PCI_CS_HEADER_TYPE 0x0e PCI_CS_BIST 0x0f PCI_CS_BASE_ADDRESS_0 0x10 PCI_CS_BASE_ADDRESS_1 0x14 PCI_CS_BASE_ADDRESS_2 0x18 PCI_CS_BASE_ADDRESS_3 0x1c PCI_CS_BASE_ADDRESS_4 0x20 PCI_CS_BASE_ADDRESS_5 0x24 PCI_CS_EXPANSION_ROM 0x30 PCI_CS_INTERRUPT_LINE 0x3c PCI_CS_INTERRUPT_PIN 0x3d PCI_CS_MIN_GNT 0x3e PCI_CS_MAX_LAT 0x3f Input config offset (hex 0x00-0xff): word to write (in hex): Loop indefinitely? (y or n)? If looping was selected, pressing any key will stop the loop.
7	Read Config DWORD	Allows the user to read from configuration space. This function has the option to single read, loop read with display and loop read without display.
8	Display Config registers 0x0 – 0xFC for device-function: 1 - 0	Reads and displays all of the configuration registers (0x0 – 0xFC) for the "active" device and function number. Use options 'S' and 'F' to change the "active" device and function numbers respectively.

Option	Function Name	Description
C	Configure BARs from a file	Reloads the PCI configuration of the "active" device from a file. It writes 0x001F to the command register and writes the 6 BARs with the values from the file. This function is useful for hot-swapping devices (power switch still required on extender), or reinitializing a device when its configuration has been altered. WARNING: Since the PCI BIOS is not assigning the BARs for this device, a memory conflict may be induced by using this option. This option is for advanced user only!
V	Save BAR configuration to a file	Writes PCI Device ID, Vendor ID and the BARs into a file (from the "active" device). This option is for advanced users only!

1.1.4 Memory Menu

Upon entering the Memory Menu from the Main Menu, AETEST will output a screen similar to the one shown in Figure 7.

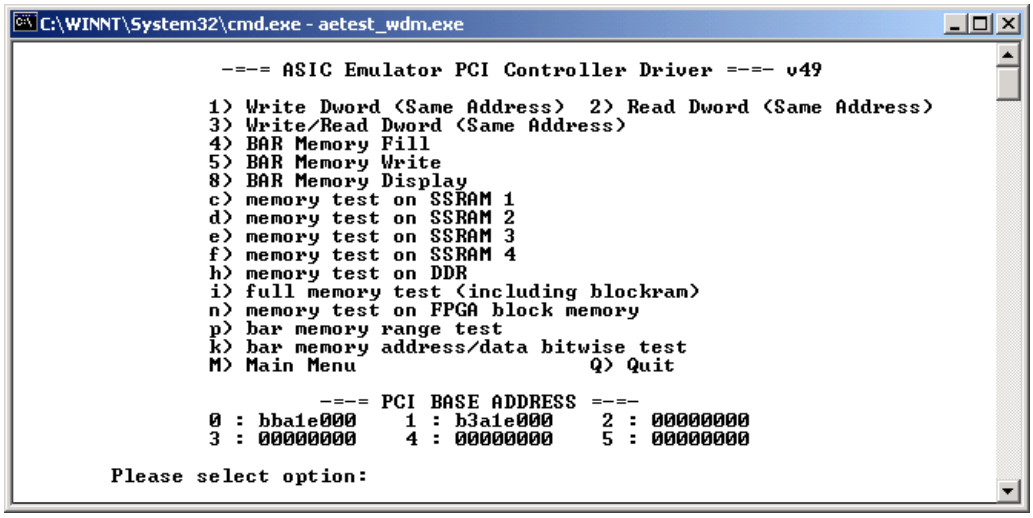

C:\WINNT\System32\cmd.exe - aetest_wdm.exe
-=-= ASIC Emulator PCI Controller Driver =-=- v49
1) Write Dword (Same Address) 2) Read Dword (Same Address)
3) Write/Read Dword (Same Address)
4) BAR Memory Fill
5) BAR Memory Write
8) BAR Memory Display
c) memory test on SSRAM 1
d) memory test on SSRAM 2
e) memory test on SSRAM 3
f) memory test on SSRAM 4
h) memory test on DDR
i) full memory test (including blockram)
n) memory test on FPGA block memory
p) bar memory range test
k) bar memory address/data bitwise test
M) Main Menu Q) Quit
-=-= PCI BASE ADDRESS =-=-
0 : bba1e000 1 : b3a1e000 2 : 00000000
3 : 00000000 4 : 00000000 5 : 00000000
Please select option:

Figure 7 - Memory Menu

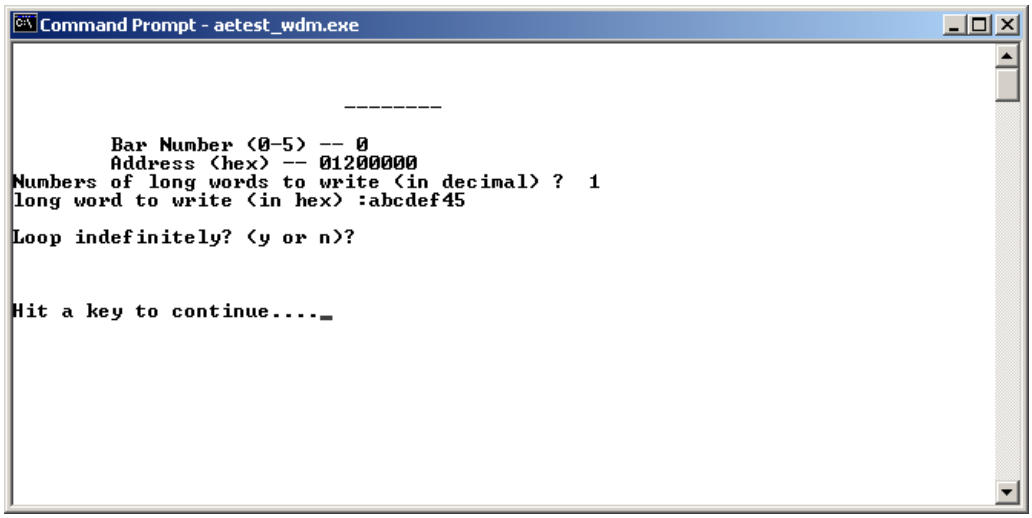
The possible Memory Menu options and their descriptions are listed below. In each description, an example transaction will be shown. The accesses will focus on SSRAM #4 at the AETEST address location of 0x200000.

NOTE: The AETEST address is offset by 2 to the left when compared to the actual SSRAM address. For example, AETEST address 0x200000 is equivalent to the SSRAM address 0x80000.

Write DWORD (Opt: 1)

'Write DWORD' allows the user to write to any location in the Base Address Registers (BAR). All 4 gigabytes of PCI memory can be accessed. A minimum of 1 to a maximum of 1024 DWORDs can be written, in sequential order, to the same address. Figure 8 shows a typical memory write.

Once the option is chosen, the user must input the BAR Number followed by the address within the specified BAR. Then, the user needs to input the number of DWORDs to be written (in decimal). The data to be written must be entered for each DWORD. Finally the user must choose to repeat the write access indefinitely or not. Pressing any key will stop a looping write.


Command Prompt - aetest_wdm.exe

Bar Number (0-5) -- 0
Address (hex) -- 01200000
Numbers of long words to write (in decimal) ? 1
long word to write (in hex) :abcdef45
Loop indefinitely? (y or n)?
Hit a key to continue....

Figure 8 - Memory Write DWORD

The transaction shown in Figure 8 writes the DWORD 0xabcdef45 to address 0x200000 of SSRAM #4.

Read DWORD (Opt: 2)

'Read DWORD' allows the user to read a DWORD from any location in the Base Address Registers (BAR). Figure 9 shows a typical memory read.

Once the option is chosen, the user must input the Bar Number followed by the address location. Then, the user is given three options:

1. AETEST will read the DWORD stored at the specified address and display it.
2. Same as option 1, however the transaction is repeated indefinitely.
3. AETEST will read the DWORD stored at the specified address repeatedly.

Options 2 and 3 are useful for debugging read transactions.

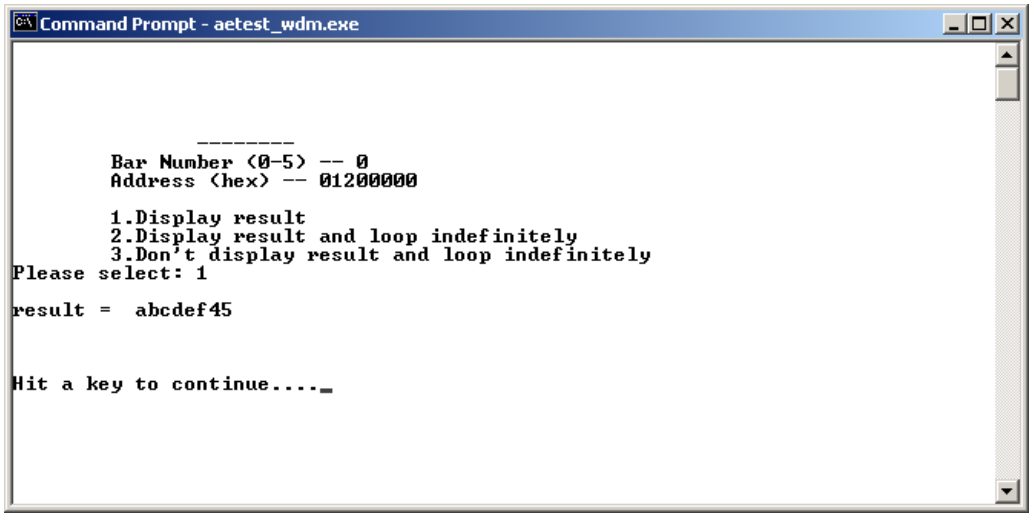


Figure 9 - Memory Read DWORD

Figure 9 shows a read of the DWORD from address 0x200000 of SSRAM #4. This read retrieves the data (0xabcdef45) written in the **Write DWORD** section (See Figure 8).

Write/Read DWORD (Opt: 3)

'Write/Read DWORD' allows the user to write a DWORD to any location in the Base Address Registers (BAR). Then, the function read back the data stored from the same address. Akin to the previous DWORD operation, all 4 gigabytes of PCI memory can be accessed. Figure 10 shows a typical memory write/read operation.

The user will be prompted, once the option is chosen, for the BAR to be accessed. Then, the memory location in hex is required. AETEST will prompt the user for the number of DWORDs to write (in decimal). Each DWORD must be individually entered. Finally, the user must choose a display option:

1. Following the write, AETEST will read the DWORD stored at the specified address and display it.

2. Same as option 1, however the transaction is repeated indefinitely.

3. AETEST will repeatedly write then read the DWORD stored at the specified address.

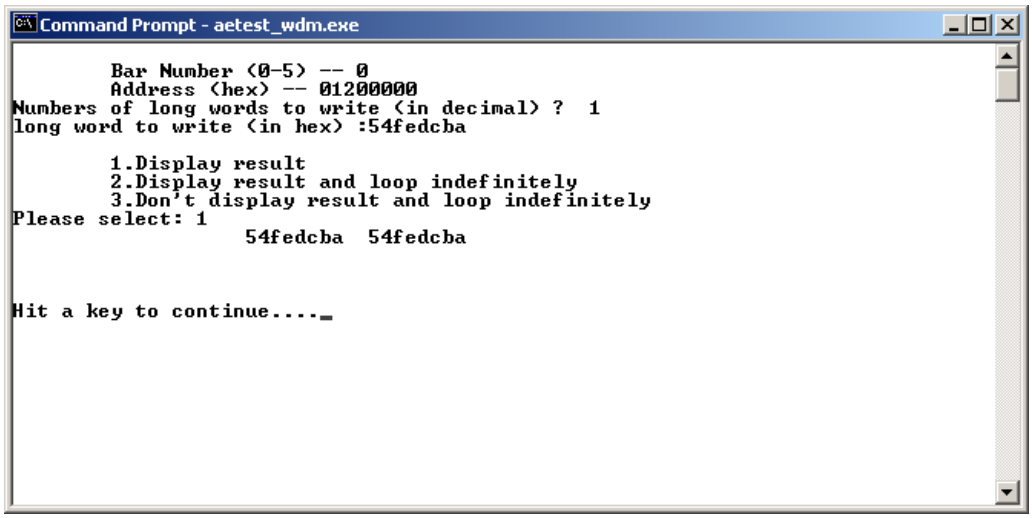

Command Prompt - aetest_wdm.exe
Bar Number (0-5) -- 0
Address (hex) -- 01200000
Numbers of long words to write (in decimal) ? 1
long word to write (in hex) :54fedcba
1.Display result
2.Display result and loop indefinitely
3.Don't display result and loop indefinitely
Please select: 1
54fedcba 54fedcba
Hit a key to continue....

Figure 10 - Memory Write/Read DWORD

Figure 10 shows a write/read of the DWORD 0x54fedcba from address 0x200000 of SSRAM #4.

Bar Memory Fill (Opt: 4)

"Bar Memory Fill" enables to user to fill a region of PCI memory space with a data selectable pattern. All 4 gigabytes of memory space is accessible. Figure 11 shows a sample transaction.

Using "Bar Memory Fill", the user must first enter the BAR Number to be accessed. Then, the starting address must be entered (in hex) and the number of bytes the user wishes to fill (in hex and divisible by 4). Finally, the user must choose from a selection data patterns:

1. Fill with 0 – fill all the locations with 0x00000000 (clear the memory)
2. Data = Address – fill each DWORD with its address
3. Alternating 0x55555555 and 0xaaaaaaaa
4. 0xffffffff – fill all of the memory bits
5. Data = ~Address – fill each DWORD with its address inverted

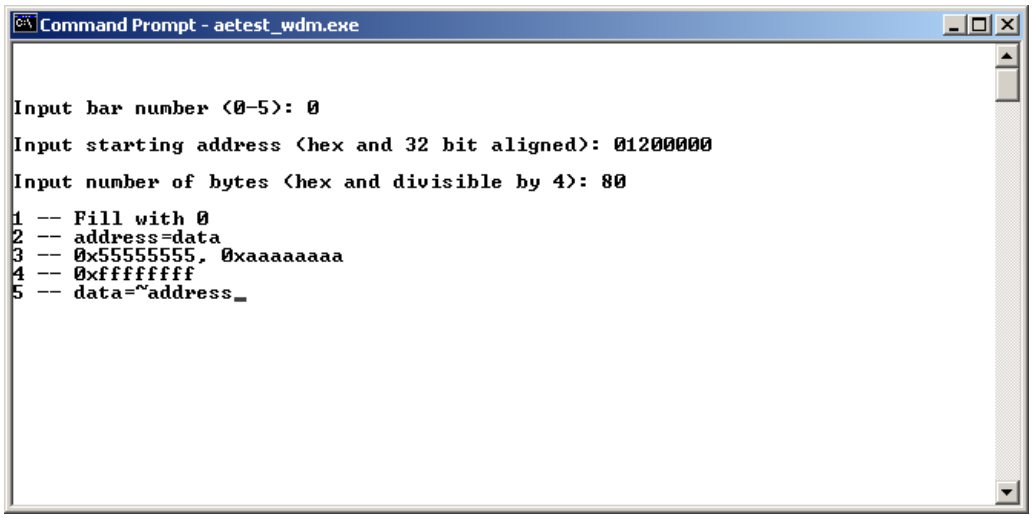

Command Prompt - aetest_wdm.exe
Input bar number (0-5): 0
Input starting address (hex and 32 bit aligned): 01200000
Input number of bytes (hex and divisible by 4): 80
1 -- Fill with 0
2 -- address=data
3 -- 0x55555555, 0xaaaaaaaa
4 -- 0xffffffff
5 -- data=~address

Figure 11 - BAR Memory Fill

As in previous function descriptions, Figure 11 shows an access of SSRAM #4. Address 0x200000 is used as the starting address and 0x80 bytes are filled. Data pattern option #3 is used. See option "Bar Memory Display" for a view of the results of this transaction.

Bar Memory Write (Opt: 5)

"Bar Memory Write" enables to user to write a DWORD(s) to PCI memory space. All 4 gigabytes of memory space is accessible. Figure 12 shows a sample transaction.

Once the option is chosen, the user must input the BAR Number followed by the address within the specified BAR. Then, the user needs to input the number of DWORDs to be written (in decimal). The data to be written must be entered for each DWORD.

Figure 12 - Bar Memory Write

The transaction shown in Figure 12 writes the DWORD 0xabcdef45 to address 0x200020 of SSRAM #4. See option "Bar Memory Display" for a view of the results of this transaction.

Bar Memory Display (Opt: 8)

"Bar Memory Display" enables to user to view 160 DWORDs of PCI memory space. All 4 gigabytes of memory space is accessible. Figure 13 shows a sample view.

The user will be prompted to choose a starting address upon selecting the "Bar Memory Display" function.

```
Input starting address (hex and 32 bit aligned):
```

The address must be in hexadecimal and 32-bit aligned.

A screen, similar to the one shown in Figure 13, will be outputted to the screen after entering the starting address. The screen will contain 20 lines of which each line lists 8 DWORDs of data. Combining the very first line and the first column on the screen specifies the corresponding address of each DWORD. For example, the DWORD of data 0x1663669b in column 5 row 6 is associated with 0x200080 (column 1) and c (row 1). Consequently, the address is 0x20008c.

Some viewing options are listed in the final line of the screen. To select an option, the user needs to press the key corresponding to the letter/number contained in the parentheses. The options are:

- Forward – View the next 160 DWORDs of data (press f)

- Back – View the previous 160 DWORDs of data (press b)
- Jump – View a newly specified location (press j)
  The user will be prompted for the new address (in hex).
- Goto – Return to the original address specified at the beginning (press 0)
- Quit – Return to Memory Menu (press q)

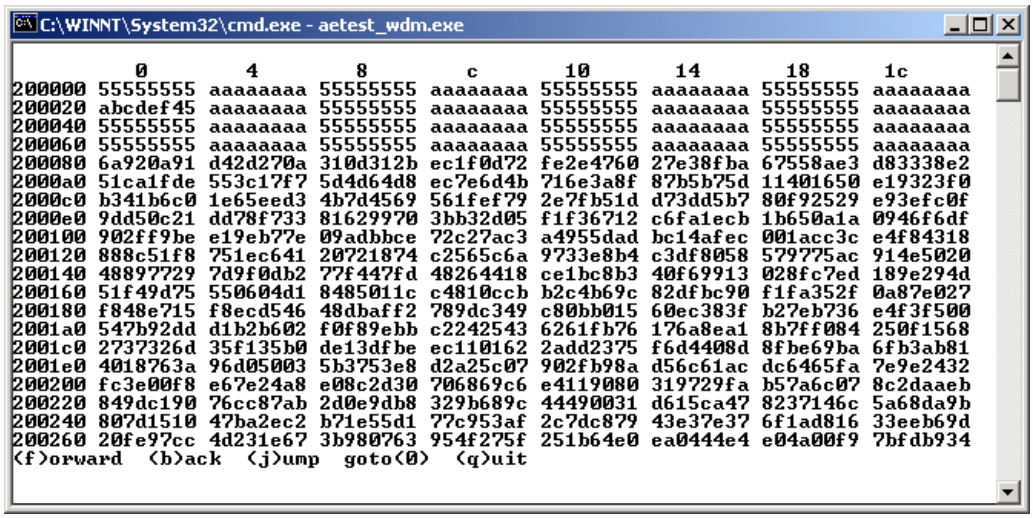


Figure 13 - Bar Memory Display

The sample view shown in Figure 13 displays 160 DWORDs of SSRAM #4 data starting at address 0x200000. The data displays the results of the transactions shown in Figure 11 and Figure 12. For Figure 11, alternating DWORDs of 0xaaaaaaaa and 0x55555555 were written starting at address 0x200000. A total of 0x80 (128 decimal) bytes of data were written. Then for Figure 12, the DWORD 0xabcdef45 was written to the address 0x200020. It is clear to see the results of the "Bar Memory Fill" and "Bar Memory Write" transactions with the "Bar Memory Display" function.

SSRAM Memory Test (Opt: c-f)

"SSRAM Memory Test" allows the user to test one of the four SSRAMs on the ET6000K10S.

DDR SDRAM Memory Test (Opt: h)

"DDR SDRAM Memory Test" allows the user to test all of the DDR SDRAMs on the ET6000K10S.

Full Memory Test (Opt: i)

"Full Memory Test" tests each of the four SSRAMs, and the Virtex-II PRO BlockRAM on the ET6000K10S.

Memory Tests On FPGA Block Memory (Opt: n)

Tests entire FPGA BlockRAM.

Bar Memory Range Test (Opt: p)

"Bar Memory Range test" is a generic memory test. It verifies the functionality of a user selectable range of PCI memory. First it prompts the user for a BAR number, a starting address offset, a DWORD count, and the number of iterations. The user is also prompted if the program should stop if error occurs, or if the program should display any errors that occur. This allows for maximum flexibility when debugging a design with an oscilloscope, or debugging any memories or memory locations on your PCI bus. The memory test is very complete, performing a write then a read to every location, a read from every location, and then a read/write/read test to every location. All other memory test options listed in the memory menu are based on this generic memory test function.

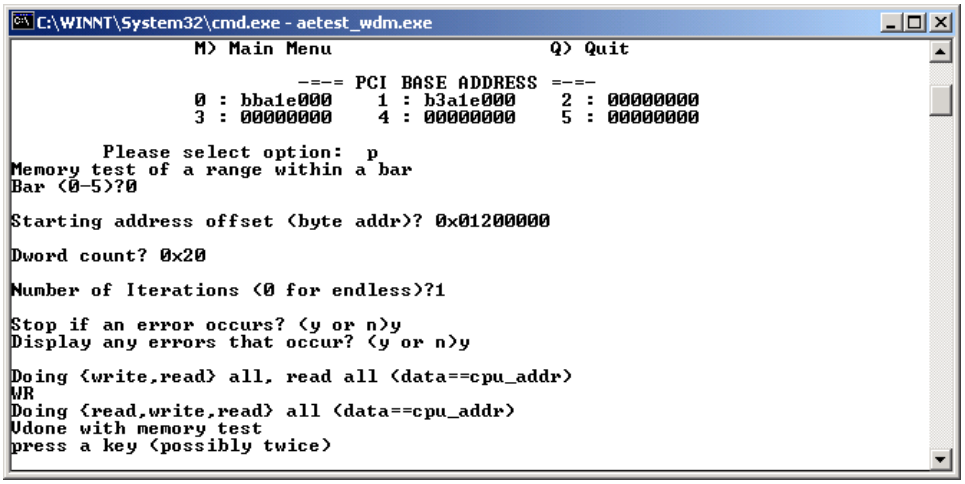

C:\WINNT\System32\cmd.exe - aetest_wdm.exe
M> Main Menu Q> Quit
-=-= PCI BASE ADDRESS =-=-
0 : bba1e000 1 : b3a1e000 2 : 00000000
3 : 00000000 4 : 00000000 5 : 00000000
Please select option: p
Memory test of a range within a bar
Bar (0-5)?0
Starting address offset (byte addr)? 0x01200000
Dword count? 0x20
Number of Iterations (0 for endless)?1
Stop if an error occurs? (y or n)y
Display any errors that occur? (y or n)y
Doing (write,read) all, read all (data==cpu_addr)
WR
Doing (read,write,read) all (data==cpu_addr)
Udone with memory test
press a key (possibly twice)

Figure 14 - Bar Memory Range Test

Bar Memory Address/Data Bitwise Test (Opt: k)

Same as "BAR Memory Range Test", except this tests the data bits one at a time.

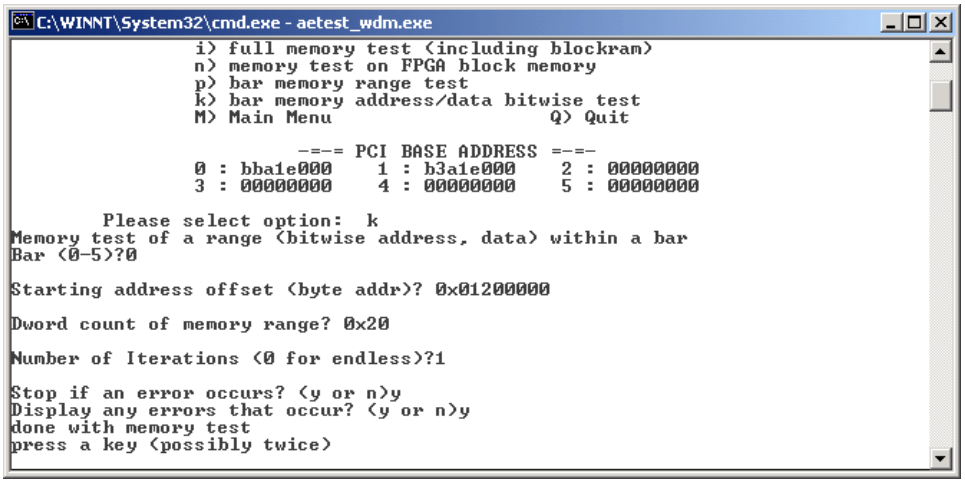

C:\WINNT\System32\cmd.exe - aetest_wdm.exe
i) full memory test (including blockram)
n) memory test on FPGA block memory
p) bar memory range test
k) bar memory address/data bitwise test
M) Main Menu Q) Quit
-=-= PCI BASE ADDRESS =-=-
0 : bba1e000 1 : b3a1e000 2 : 00000000
3 : 00000000 4 : 00000000 5 : 00000000
Please select option: k
Memory test of a range (bitwise address, data) within a bar
Bar (0-5)?0
Starting address offset (byte addr)? 0x01200000
Dword count of memory range? 0x20
Number of Iterations (0 for endless)?1
Stop if an error occurs? (y or n)y
Display any errors that occur? (y or n)y
done with memory test
press a key (possibly twice)

Figure 15 - Bar Memory Address/Data Bitwise Test

1.1.5 Flash Menu

Upon entering the Flash Menu from the Main Menu, AETEST will output a screen similar to the one shown in Figure 16.

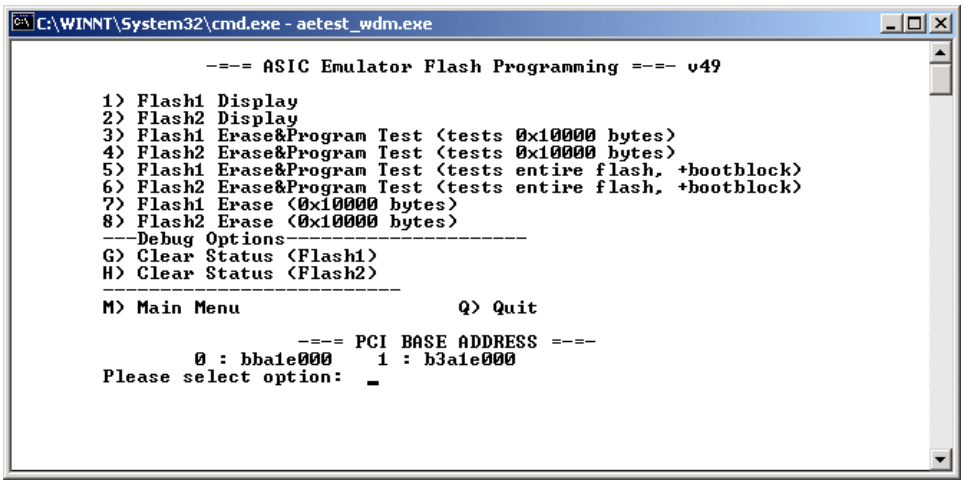

C:\WINNT\System32\cmd.exe - aetest_wdm.exe
-=-= ASIC Emulator Flash Programming =-=- v49
1) Flash1 Display
2) Flash2 Display
3) Flash1 Erase&Program Test (tests 0x10000 bytes)
4) Flash2 Erase&Program Test (tests 0x10000 bytes)
5) Flash1 Erase&Program Test (tests entire flash, +bootblock)
6) Flash2 Erase&Program Test (tests entire flash, +bootblock)
7) Flash1 Erase (0x10000 bytes)
8) Flash2 Erase (0x10000 bytes)
---Debug Options----------
G) Clear Status (Flash1)
H) Clear Status (Flash2)
M) Main Menu Q) Quit
-=-= PCI BASE ADDRESS =-=-
0 : bba1e000 1 : b3a1e000
Please select option:

Figure 16 - Flash Menu

The possible Flash Menu options and their descriptions are listed below.

Flash Display (Opt: 1, 2)

Displays Flash Memory content.

Flash Erase & Program Test (tests 0x10000 bytes) (Opt: 3, 4)

Erase and Test the first 0x10000 bytes of the flash.

Flash Erase & Program Test (tests entire flash, +bootblock) (Opt: 5, 6)

Erase and Test the entire flash, including boot block, this test takes approximately 5 minutes.

Flash Erase (0x10000 bytes) (Opt: 7, 8)

Erase the first 0x10000 bytes of the flash.

Clear Status (Opt: G, H)

Clear error status bits, in case any errors occurred.

1.1.6 Daughter Board Menu

Upon entering the Daughter Board Menu from the Main Menu, AETEST will output a screen similar to the one shown in Figure 17.

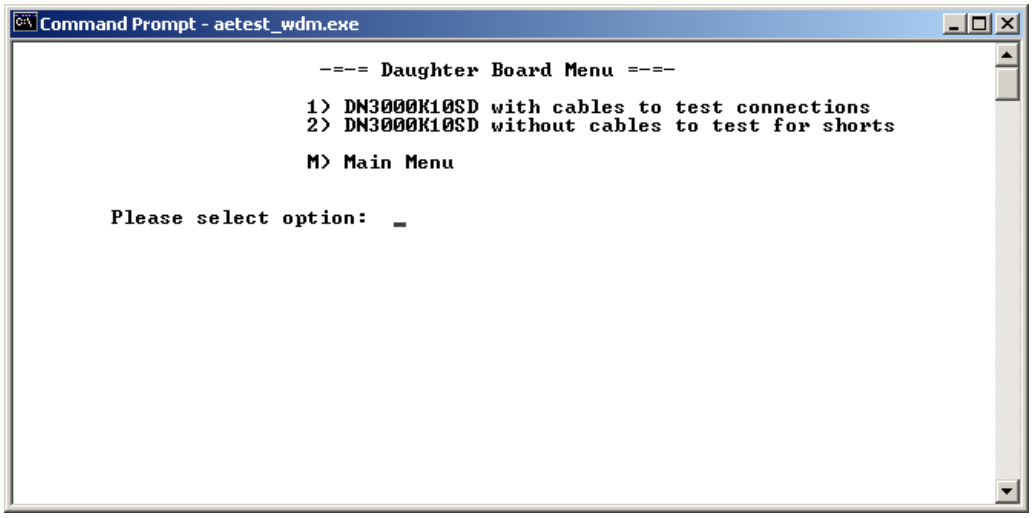

Command Prompt - aetest_wdm.exe
-=-= Daughter Board Menu =-=-
1> DN3000K10SD with cables to test connections
2> DN3000K10SD without cables to test for shorts
M> Main Menu
Please select option:

Figure 17 - Daughter Board Menu

The possible Daughter Board Menu options and a description can be found in Table 4.

Table 4 - Daughter Board Options

Option	Function Name	Description
1	ET3000K10SD w/ cables	The FPGA outputs a signal to the Daughter Board where it is sent/driven back to the FPGA. The data is compared for correctness. This is repeated for all test header signals.

Option	Function Name	Description
2	ET3000K10SD w/o cables	All IO signals on the ET6000K10S are driven to ground. Then, the option performs a walking 1s test for all of the test header signals. The test checks for shorts on the ET6000K10S.

1.2 GNU Tools

GNU software is used to develop software for the Virtex-II Pro family of FPGAs. This includes the GNU C compiler (GCC), the GNU binary utilities (binutils), the GNU debugger (GDB), and the GNU make program. From the GNU Project website, http://www.gnu.org/:

The GNU Project was launched in 1984 to develop a complete Unix-like operating system, which is free software: the GNU system. (GNU is a recursive acronym for GNU's Not Unix; it is pronounced 'guh-NEW'.) Variants of the GNU operating system that use the Linux kernel are now widely used; though these systems are often referred to as "Linux," they are more accurately called GNU/Linux systems. As a prerequisite for the development of the GNU system, many different software packages-compilers, assemblers, linkers, debuggers, libraries, and other tools-had to be programmed.

2 Getting More Information

2.1 Printed Documentation

The printed documentation, as mentioned previously, takes the form of a Virtex-II Pro datasheet and an ET6000K10S User Guide.

2.2 Electronic Documentation

Multiple documents and datasheets have been included on the CD:

2.3 Online Documentation

There is a public access site that can be found on Emulation Technology web site at http://www.emulation.com/.

Chapter 5

Programming/Configuring the Hardware

This chapter details the programming and configuration instructions for the ET6000K10S.

1 Programming the CPLD

Code updates will be posted on Emulation Technology website. The user is required to purchase the Xilinx Development Tools if in-house development is required. The tools are available from Xilinx, (http://www.xilinx.com/).

This section lists detailed instructions for programming the CPLD using the Xilinx ISE 6.1i tools.

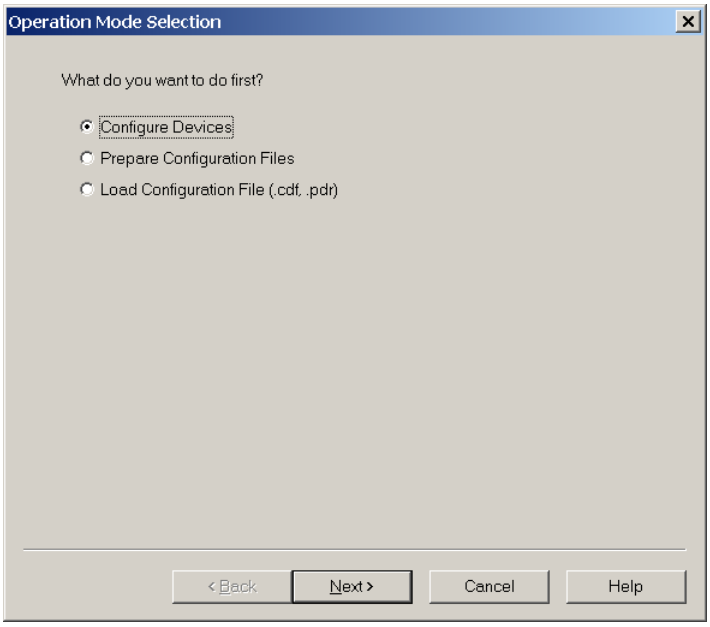
Note: This user guide will not be updated for every revision of the Xilinx tools, so please be aware of minor differences.

1. The ET6000K10S must be powered with the Xilinx JTAG cable connected to header P7 and the other end to a serial port on the PC.

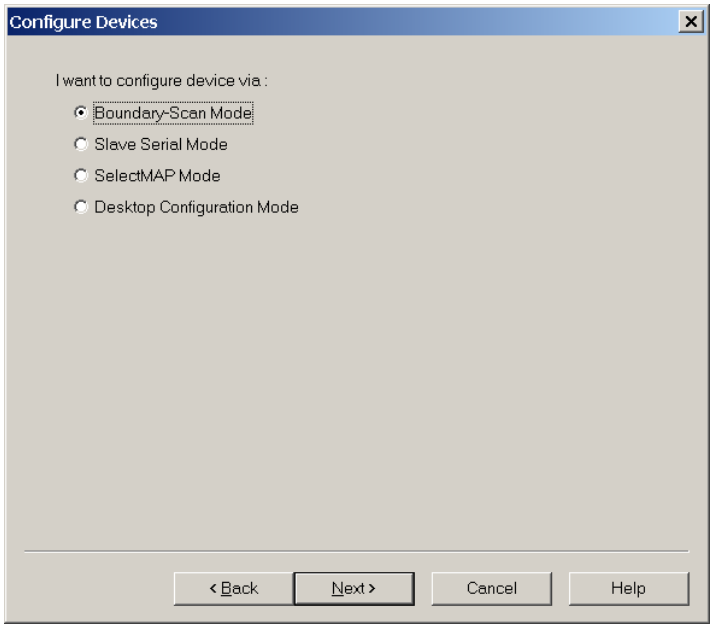
2. Download the latest programming file for the CPLD from Emulation Technology website (filename "CPLD.JED") http://www.emulation.com/.

3. Run iMPACT - From the Windows **START** menu, choose **PROGRAMS → Xilinx ISE 6 → Accessories → iMPACT.**

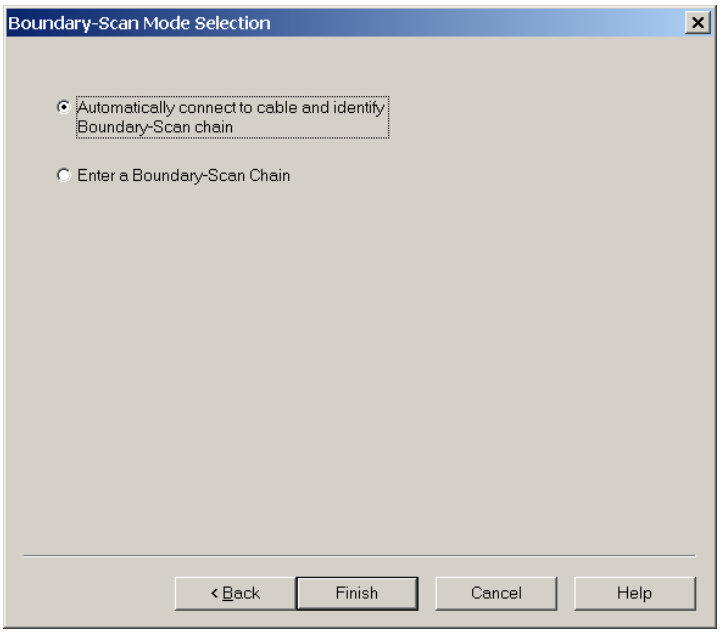
4. Select the **Configure Devices** option and proceed by clicking the **NEXT** button**.**



5. Select the **Boundary-Scan Mode** option and proceed by clicking the **NEXT** button**.**



6. Select the **Automatically connect to cable and identify Boundary-Scan chain** option and proceed by clicking the **NEXT** button**.**

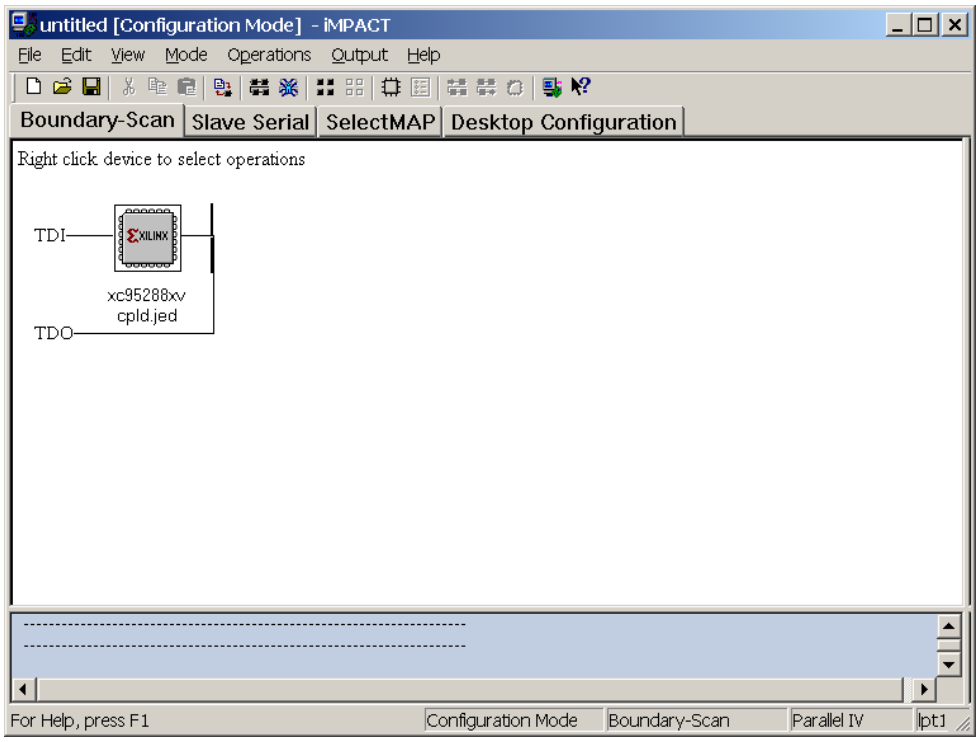


7. If the process was successful the following window will appear:

Boundary-Scan Chain Contents Summary
There was one device detected in the boundary-scan chain. iMPACT will now direct you to associate a programming or BSDL file with this device...
OK

8. Click **OK** button.

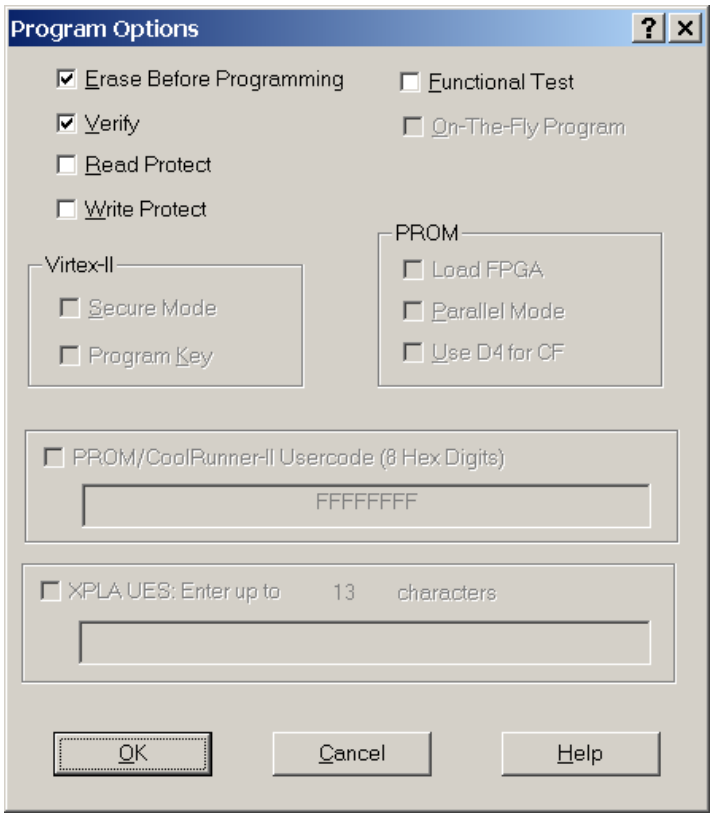
9. Enter the location of the CPLD.JED file in the window prompting the file name and click **OK**. The following window would be displayed:



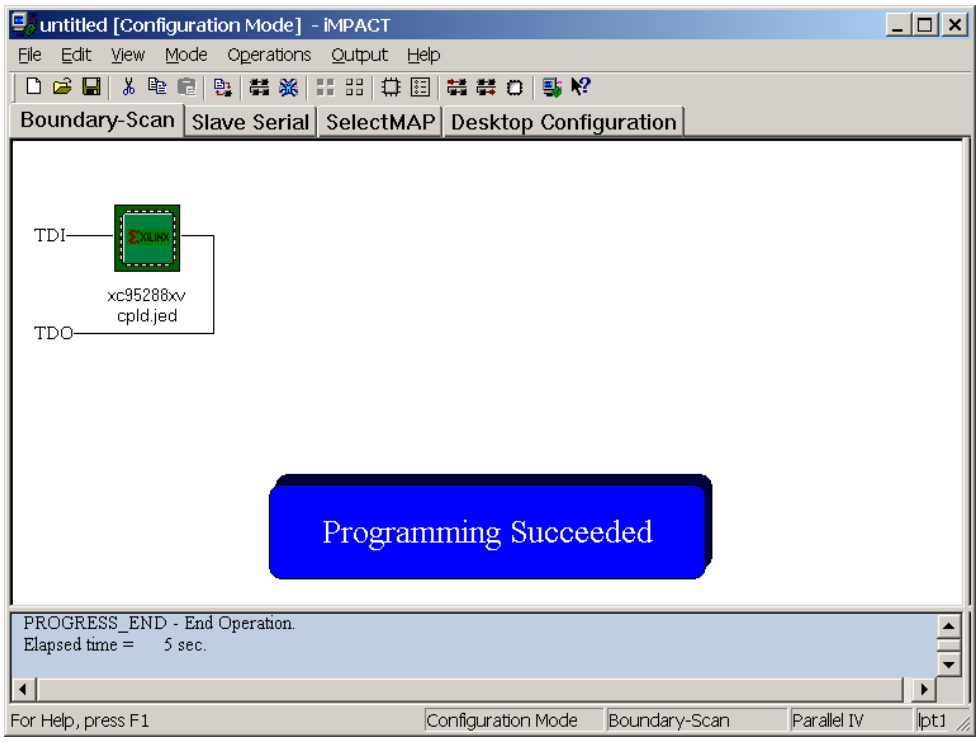
Note: The device selected should be XC95288XV.

10. Select the device, right click and select **Program** option.

11. Select the **Erase before programming** and the **Erase** option before clicking the **OK** button.



12. The device will be programmed with the file selected. If programming was successful, the following window will appear.



13. The CPLD is now programmed, proceed with programming the MCU.

2 Programming the MCU

Code updates will be posted on Emulation Technology website. The user is required to purchase the IAR Compiler if in-house development is required. The compiler is available from IAR, (**http://www.iar.com/**). The part number is EWA90PCUBLV150.

In order to program the MCU, install AVR Studio 4.07 from Atmel (http://www.atmel.com/). This program is freeware and is also included on the CD-ROM. **The CPLD must be programmed before the MCU can be programmed, see** Programming the CPLD. This section lists detailed instructions for programming the MCU using the AVR tools.

Note: This user guide will not be updated for every revision of the Atmel AVR tools, so please be aware of minor differences.

1. The ET6000K10S must be powered with the Atmel AVR cable connected to MCU ISP header P1 and the other end to a serial port on the PC.

2. The MCU RS232 serial port is required to complete the initialization phase after the MCU has been programmed. See Configuring HyperTerminal.

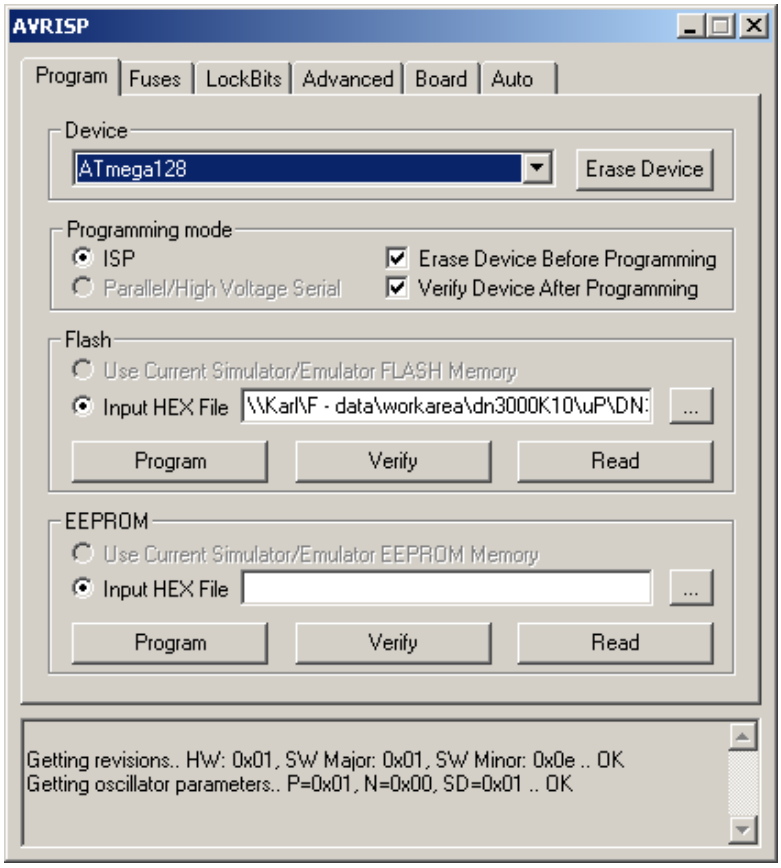
3. Download (and unzip) the latest programming file for the MCU from Emulation Technology website (Processor and CPLD update) http://www.emulation.com/.

4. Run AVR Studio - From the Windows **START** menu, choose **PROGRAMS → Atmel AVR Studio 4**.

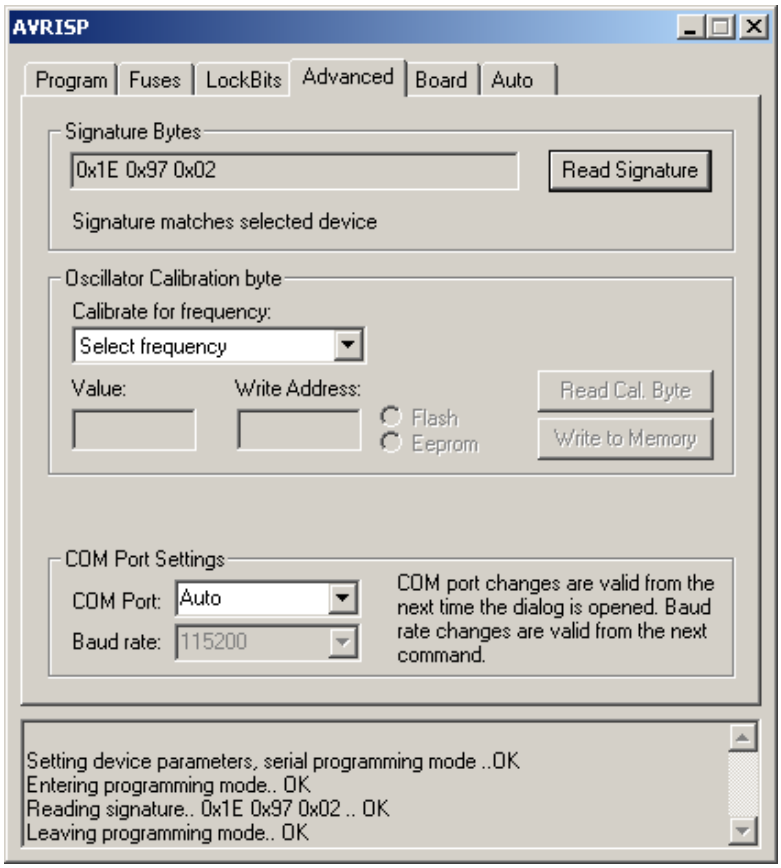
5. Cancel the "Welcome to AVR Studio 4" window by clicking cancel button.

6. Select **TOOLS → STK500/AVRISP/JTAG ICE** and a new window should appear:

7. In the Device list, select the Atmega128 and in Flash window, point to the location of the MCU programming file "ET6000K10S.A90".

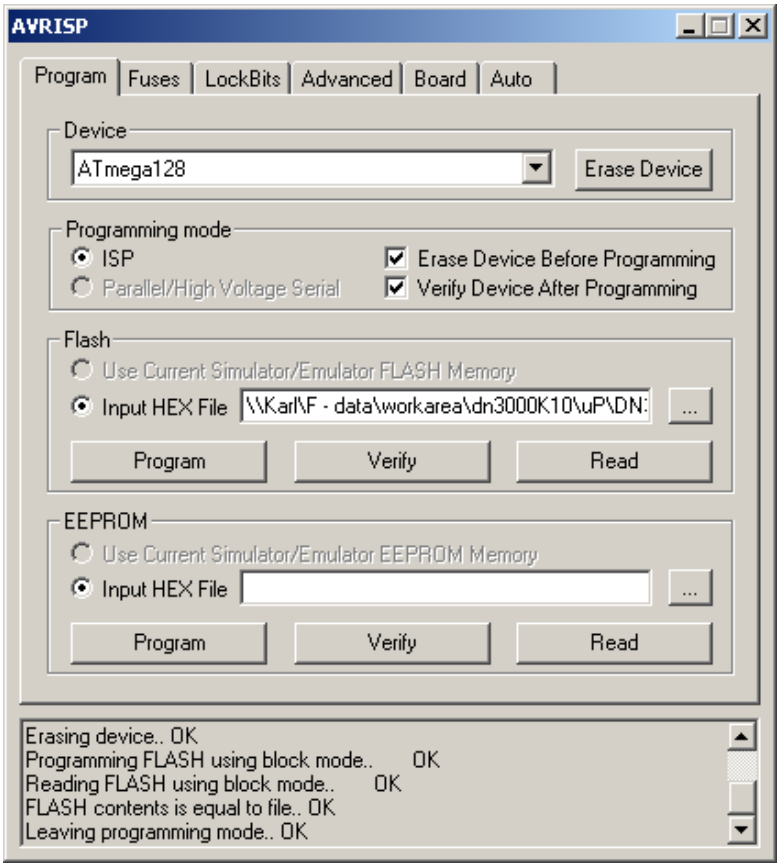


8. Select the **Advanced** tab and read the device signature by selecting the **Read Signature** button.



9. Select the **Program** tab and program the device by selecting the **Program** button in the Flash window.

10. The device is now programmed and the status window should report the following:



11. After programming the processor, close all AVR Studio windows and open the HyperTerminal Window. Press ENTER to display the first initialization instruction.

> Note: Connecting the serial port is mandatory to complete the initialization process. The FPGA cannot be configured via the SmartMedia card until you have completed all the instructions in this section

12. Enter number of FPGAS on board (1-6): 1

13. Please select the first FPGA on the board (F, A, E, B, or D): F

14. Please enter selection (1-6): for FPGA F: 9

15. The initialization process will then be completed and present the user with the FPGA configuration main menu.

The FPGA is now ready to be configured, see Configuring the FPGA using SelectMap.

3 Configuring HyperTerminal

A terminal emulator is required to monitor MCU transactions. Emulation Technology suggests using the Windows-based program - HyperTerminal (Hypertrm.exe). The configuration file for HyperTerminal "ET6000K10S.ht" is supplied on the CD-ROM or can be downloaded from Emulation Technology website.

The RS232 port is configured with the following parameters:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop Bits: 1
- Flow control: None
- Terminal Emulation: VT100

A cable that converts the 5 x 2 header to a DB9 is shipped with the ET6000K10S. Insert the 5 x 2 header into the MCU RS232 header P5. P5 is not keyed - ensure correct pin orientation.

Note: MCU RS232 Header P5 is not keyed. Ensure correct pin orientation. Pin 1 is indicated with a letter 1 on the board silkscreen, as well as a dot. Pin 1 on the 5 X 2 cable header is indicated with a triangular shape printed on the connector.

A female-to-female RS232 cable is provided with the ET6000K10S. This cable will attach directly to the RS232 port of a PC. Emulation Technology suggests Jameco as a possible supplier, (http://www.jameco.com). The part number is 132345. Male-to-female extension cables are part number 25700.

4 Configuring the FPGA using SelectMAP

The simplest mode of configuration for the ET6000K10S' Virtex-II PRO FPGA involves the SelectMAP configuration method using a SmartMedia card. The ET6000K10S ships with two 32 MB SmartMedia cards. One of these SmartMedia cards contains a reference design bit file produced for SelectMAP configuration, and a file named "main.txt" that sets the configuration options (see "Creating Configuration File main.txt"). The SmartMedia card containing the reference design has been write

protected by the application of the silver write protect sticker on the card. The other SmartMedia card is empty and available for user applications. To configure the FPGA with the reference design, please skip to "Starting SelectMAP Configuration".

Status messages are reported by the MCU via the RS232 serial port during FPGA configuration. It is **NOT** necessary to have the serial port connection in order to configure the FPGA in SelectMAP mode. However, if an error occurs during the configuration, the user would be able to identify possible problems by viewing the configuration status messages. See Configuring HyperTerminal on how to setup the serial port.

4.1 Bit File Generation for SelectMAP Configuration

Configuring the ET6000K10S' Virtex-II PRO FPGA requires the generation of bit files by the Xilinx ISE tools.

NOTE: This user guide will not be updated for every revision of the Xilinx tools, so please be aware of minor differences. The Xilinx ISE 6.1i revision is used here.

The CPLD and MCU must be programmed before executing the following instructions.

First, a project must be created. Open the Xilinx ISE **Project Navigator** software package. Go to the File menu and select **New Project**. A "New Project" dialog box will pop up shown in Figure 20.

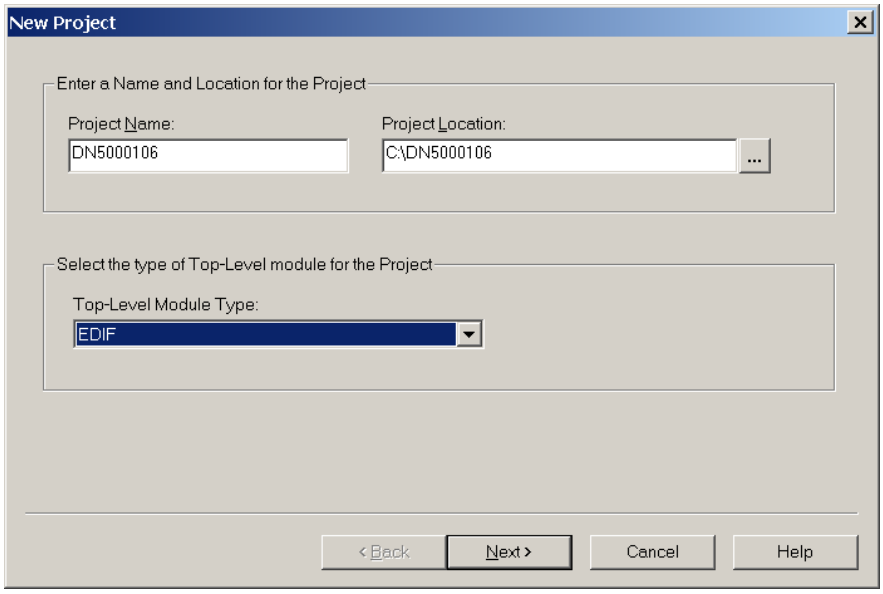


Figure 18 - New Project Screen Shot

Select the input files for the project, refer to Figure 19.

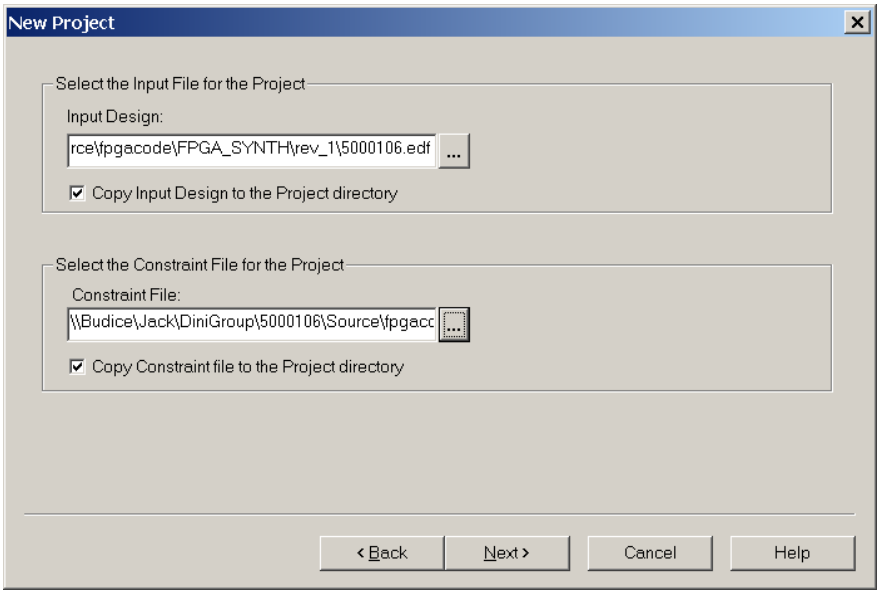


Figure 19 - Input File

Select the device and the design flow for the project. The user must specify a project name and location. The correct property values must be selected, refer to Figure 20:

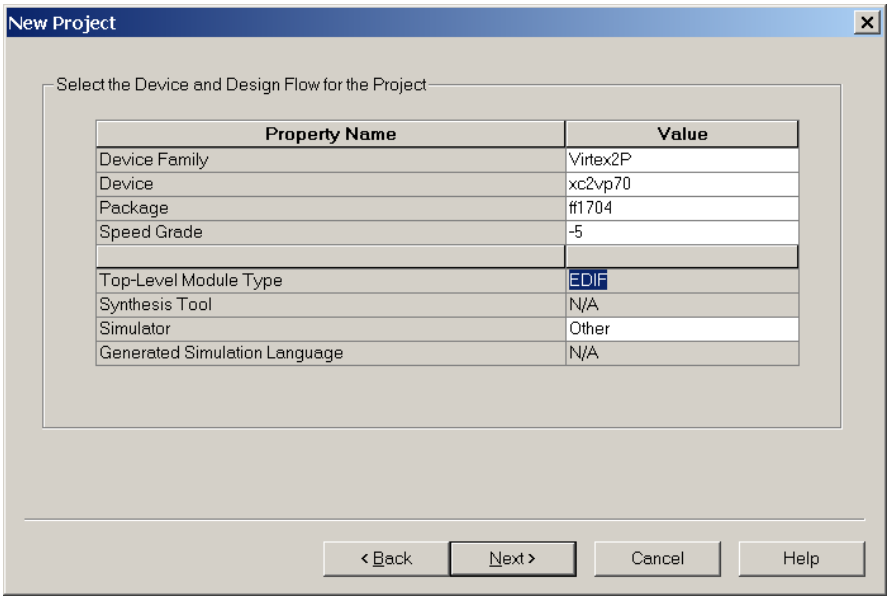


Figure 20: New Project Dialog Box

The Project Navigator will create a new project with the required files.

Emulation Technology prefers to use Synplicity's, Synplify for synthesis (which is recommended for the user also). Consequently, edif files are used in the design flow described here.

Selecting the edif file in the "Module View" window, the user's Project Navigator box should resemble Figure 21.

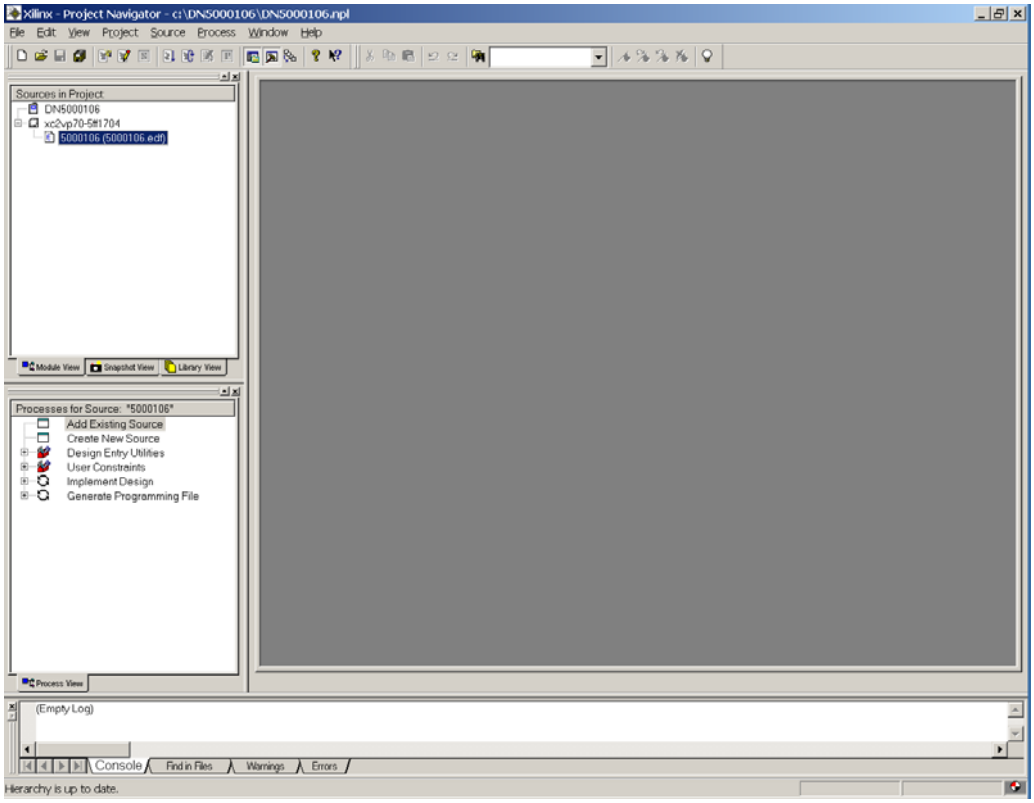
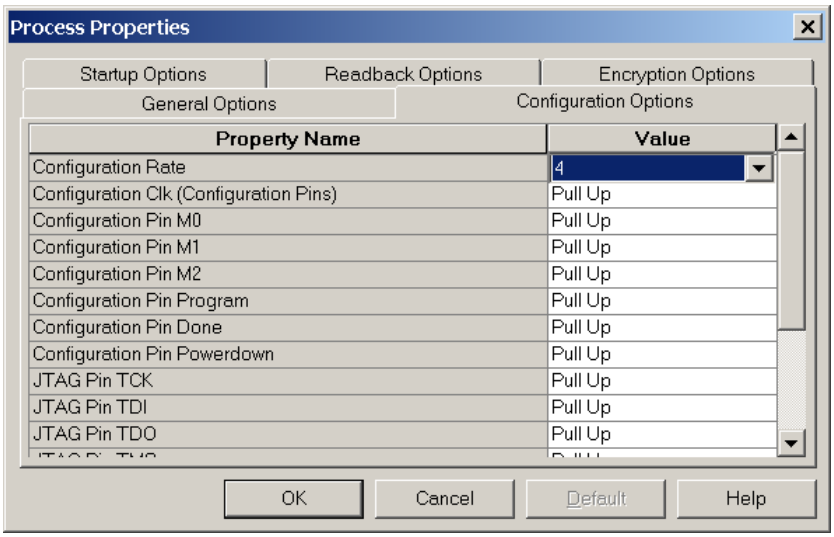


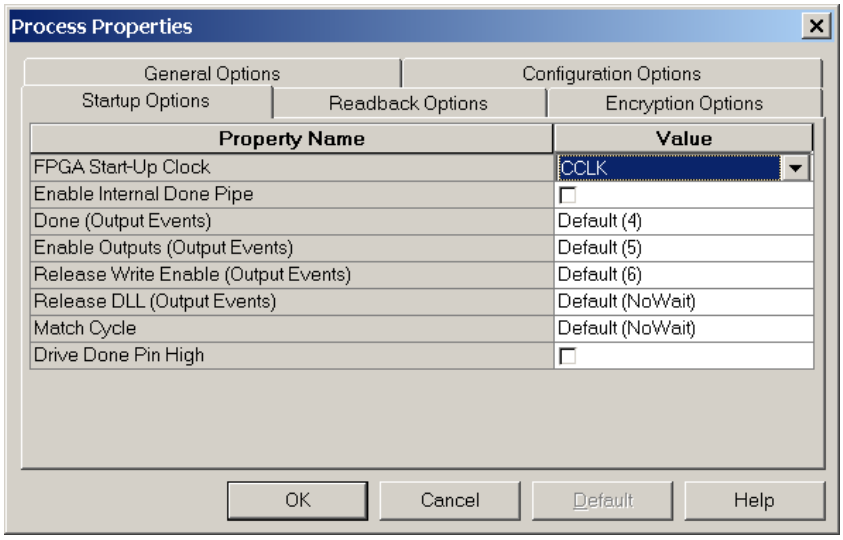
Figure 21: Project Navigator

In the "Process for Source" window, a process is signified by the icon . In the "Process for Source" window, the user must right-click on the "Generate Programming File" process and select properties. The default settings are correct (The user should verify a couple important options, right-click and selecting properties options).

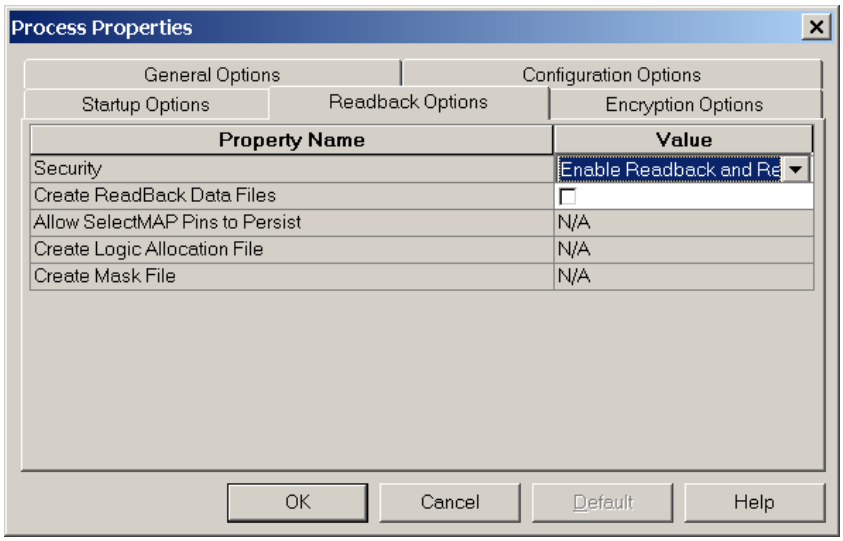
- Configuration Options Tab: Configuration Pin Powerdown = **Pull Up**



- Startup Options Tab: FPGA Start-up Clock = **CCLK**



- Readback Options Tab: Security = **Enable Readback and Reconfiguration**



The user can now generate the bit file. In the "Process for Source" window, the user must right-click on the "Generate Programming File" process and select Run. The bit file will be generated and may be found in the project directory.

4.2 Creating Configuration File "main.txt"

To control which bit file on the Smart Media card is used to configure the FPGA in SelectMAP mode a file named "main.txt" must be created and copied to the root directory of the Smart Media card. The configuration process cannot be performed without this file. Below is a description of the options that can be set in the file, a description of the format this file needs to follow, and an example of a main.txt file.

4.2.1 Verbose Level

During the configuration process, there are three different verbose levels that can be selected for the serial port messages:

- Level 0:
  - Fatal error messages
  - Bit file errors (e.g., bit file was created for the wrong part, bit file was created with wrong version of Xilinx tools, or bitgen options are set incorrectly)
  - Initializing message will appear before configuration
  - A single message will appear once the FPGA is configured
- Level 1:
  - All messages that Level 0 displays
  - Displays configuration type (should be SelectMAP)

  - Displays current FPGA being configured if the configuration type is set to SelectMAP
  - Displays a message at the completion of configuration for each FPGA configured.
- Level 2:
  - All messages that Level 1 displays
  - Options that are found in "main.txt"
  - Bit file names for each FPGA as entered in main.txt
  - Maker ID, device ID, and size of Smart Media card
  - All files found on Smart Media card
  - If sanity check is chosen, the bit file attributes will be displayed (part, package, date, and time of the bit file)
  - During configuration, a "." will be printed out after each block (16 KB) has successfully been transferred from the Smart Media to the current FPGA

4.2.2 Sanity Check

The Sanity Check, if enabled, verifies that the bit file was created for the right part, the right version of Xilinx was used, and the bitgen options were set correctly. If any of the settings found in the bit file are not compatible with the FPGA, a message will appear from the serial port, and the user will be asked whether or not they want to continue with the bit file. Please see the section Bit File Generation for SelectMAP Configuration for details on which bitgen options need to be changed from the default settings. A PC version of the sanity check can be run on your bit files before copying them onto the Smart Media card; see section PC Bit File Sanity Check for more details.

4.2.3 Format of "main.txt"

The format of the main.txt file is as follows:

1. The first nonempty/uncommented line in main.txt should be:

   Verbose level: X

   where "X" can be 0, 1 or 2. If this line is missing or X is an invalid level, then the default verbose level will be 2.

2. The second nonempty/uncommented line in main.txt tells whether or not to perform a sanity check on the bit files before configuring an FPGA:

   Sanity check: y

where "y" stands for yes, "n" for no. If the line is missing or the character after the ":" is not "y" or "n" then the sanity check will be enabled.

3. For each FPGA that the user wants to configure, there should be exactly one entry in the main.txt file with the following format:

   FPGA F: example.bit

   In the above format, the "F" following FPGA is to signal that this entry is for FPGA F, and FPGA F would then be configured with the bit file example.bit. The ET6000K10S only has one FPGA, which is FPGA F. There can be any number of spaces between the ":" and the configuration file name, but they need to be on the same line.

4. Comments are allowed with the following rules:

   - All comments must start at the beginning of the line.
   - All comments must begin with //
   - If a comment spans multiple lines, then each line should start with //

   Commented lines will be ignored during configuration, and are only for the user's purpose.

5. The file main.txt is NOT case sensitive.

Example of "main.txt":

```
//start of file "main.txt"
Verbose level: 2
Sanity check: y
FPGA F: fpgaF.bit
//the line above configures FPGA F with the bit file "fpgaF.bit"
//end of main.txt
```

Given the above example file: Verbose level is set to 2, a sanity check on the bit files will be performed, and FPGA F will be configured with file fpgaF.bit.

NOTE: All configuration file names have a maximum length of eight (8) characters, with an additional three for the extension. Do not name your configuration bit files with long file names. In addition, all file names should be located in the root directory of the Smart Media card—no subdirectories or folders are allowed. Since the "main.txt" file controls which bit file is used to configure the FPGA, the Smart Media card can contain other bit files.

4.3 Starting SelectMAP Configuration

If using the reference design, SmartMedia card that came with the ET6000K10S then no files need to be copied to the card. Otherwise, copy your bit file and "main.txt" to the root directory of the SmartMedia card using the FlashPath floppy adapter or some other means. Make sure the dipswitch (S2) is set for SelectMAP as shown in Table 5.

Table 5: S2 Dipswitch Configuration Settings

Signal Name	Pins	Status
FPGA_MSEL0	Pins 1 & 8	Closed
FPGA_MSEL1	Pins 2 & 7	Open
FPGA_MSEL2	Pins 3 & 6	Open
DIP_SW3	Pins 4 & 5	X

Set up the serial port connection as described above in Configuring HyperTerminal. Next, place the SmartMedia card in the SmartMedia socket on the ET6000K10S and turn on the power (NOTE: the card can only go in one way). The SmartMedia card is hotswappable and can be taken out or put into the socket even when the power is on. Once the power has been turned on, the configuration process will begin as long as there is a valid SmartMedia card inserted properly in the socket. If there is not a valid SmartMedia card in the socket, then DS1 will be lit (see Table 32 for GPIO LED's) and the Main Menu will appear from the serial port.

A SmartMedia card is determined to be invalid if either the format of the card does not follow the SSFDC specifications, or if it does not contain a file named main.txt in the root directory. If the configuration was successful, a message stating so will appear and the Main Menu will come up. Otherwise, an error message will appear. The LEDs on DS1 and DS2 give feedback during and after the configuration process (see Table 32 for GPIO LED's for further details).

After the FPGA has been configured, the following Main Menu will appear via the serial port, refer to Figure 22.

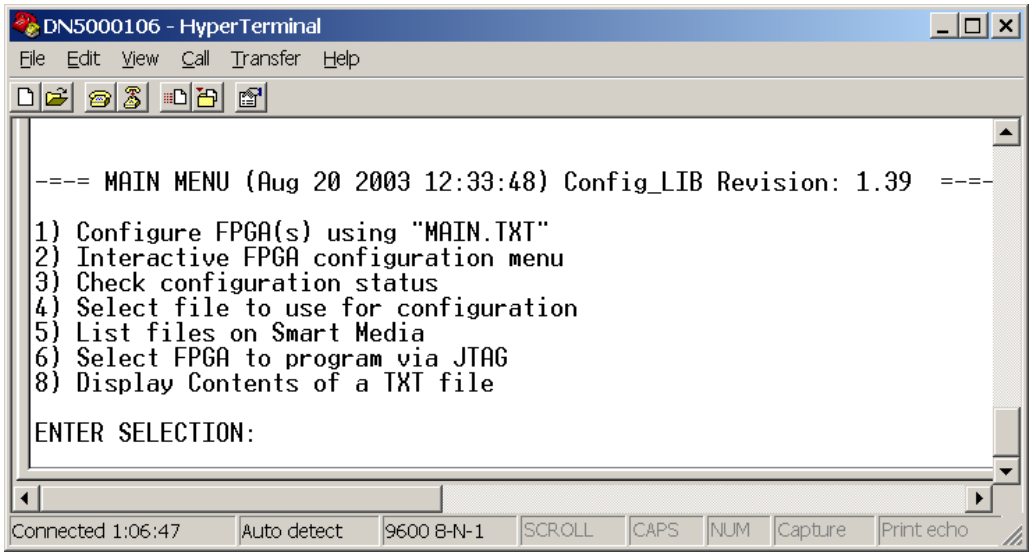


Figure 22 - Main Menu

The HyperTerminal interface gives the user an easy method for handling and monitoring the ET6000K10S' FPGA configuration.

4.3.1 Description of Main Menu Options.

Table 6 describes the Main Menu options found on the HyperTerminal interface.

Table 6: HyperTerminal Main Menu Options

Option	Function	Description
1	Configure FPGA's in Using "main.txt" as the Configuration File	The FPGA will configure in SelectMAP mode. You can also press the reset button (S1) to reconfigure the FPGA in Select-MAP mode.
2	Interactive FPGA configuration menu	This option takes you to a menu titled "Interactive Configuration Menu" and allows the FPGA to be configured through a set of menu options instead of using the main.txt file. The menu options are described in .
3	Check Configuration Status	This option checks the status of the DONE pin and prints out whether or not the FPGA(s) have been configured along with the file name that was used for configuration.

Option	Function	Description
4	Select file to use in place of main.txt	By default, the processor uses the file main.txt to get the name of the bit file to be used for configuration as well as options for the configuration process. However, a user can put several files that follow the format for main.txt on the SmartMedia card that contain different options for the configuration process. By selecting the main menu option 4, the user can select a file from a list of files that should be used in place of main.txt. After selecting a new file to use in place of main.txt, the user should select Main Menu option 1 to configure the FPGA(s) according to this new file. If the power is turned off or the reset button (S1) is pressed, the configuration file is changed back to the default, main.txt.
5	List files on SmartMedia	This option prints out a list of all the files found on the SmartMedia card.
6	Select FPGA to program via JTAG	This option allows the user to select an FPGA to configure via JTAG.
8	Display Contents of a TXT File	This option allows the use to list the contents of any text file on the Smart Media card.

Selecting "Option 2" results in the following menu to be displayed, refer to Figure 23.

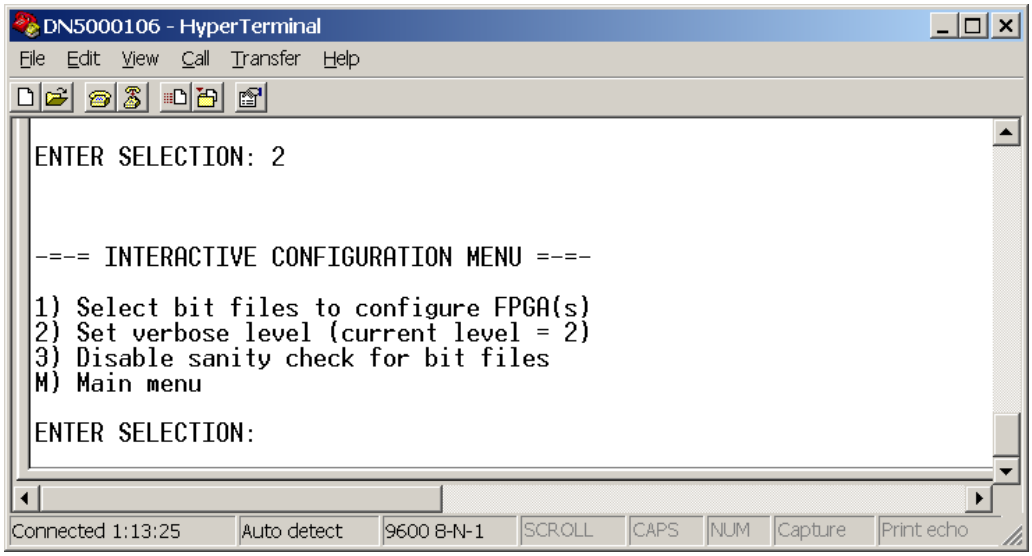


Figure 23 - Interactive Configuration Option Menu

Table 7 describes the Interactive Configuration Menu options:

Table 7: HyperTerminal Interactive Configuration Menu Options

Option	Function	Description
1	Select a bit file to configure FPGA(s)	The user is able to select a bit file from a list of bit files found on the SmartMedia card for configuring the FPGA.
2	Set verbose level (current level = 2)	The user can change the verbose level from the current setting. NOTE: If the user goes back to the main menu and configures the FPGA(s) using main.txt, the verbose level will be set to whatever setting is specified in main.txt.
3	Disable/Enable sanity check for bit files	The user can disable or enable the sanity check, depending on what the current setting is. NOTE: If the user goes back to the main menu and configures the FPGA(s) using main.txt, the sanity check will be set to whatever setting is specified in main.txt.
M	Main menu	Returns the user to the Main Menu.

4.4 PC Bit File Sanity Check

A version of the sanity check has been compiled for use on a PC; the executable is sanityCheck.exe, which can be found on the CD shipped with the ET6000K10S. This allows you to run the sanity check on bit files before copying them onto the Smart Media card. This PC bit file sanity check verifies that the right version of Xilinx tools was used and the bitgen options have been set correctly. To run the sanity check from the command line:

```
%sanityCheck –f fpga.bit –d –s
```

See Table 8 for command line options.

Table 8: Sanity Check Command Line Options

Command Line Option	Required or Optional	Description
f	Required	This option must be followed by the name of the bit file to perform the sanity check on.
d	Optional	This option prints out a description of the different bitgen options and their

Command Line Option	Required or Optional	Description
		different values.
s	Optional	This option prints out the current bitgen settings found in the file specified with the -f option.

If the bit file passes the sanity check, you should see something similar to:

```
$ sanityCheck -f fpga_sm.bit

** Performing Sanity Check on File: fpga_sm.bit **

DATE: 2003/07/16

TIME: 10:47:01

PART: 2vp70ff1704

FILE SIZE = 3262448 bytes

ALL BITGEN OPTIONS ARE SET CORRECTLY
```

If the bit file does not pass, then a message stating why it didn't pass will print out. For example:

```
$ sanityCheck -f fpga_sm.bit

** Performing Sanity Check on File: fpga_sm.bit **

DATE: 2003/17/03

TIME: 10:47:01

PART: 2vp70ff1704

FILE SIZE = 3262448 bytes

ERROR: PowerDown status pin is enabled, you must disable this option to
configure the FPGA in SelectMAP mode.
```

4.5 Bitstream Encryption

Virtex-II Pro devices have an on-chip decryptor using one or two sets of three keys for triple-key Data Encryption Standard (DES) operation. Xilinx software tools offer an optional encryption of the configuration data (bitstream) with a triple- key DES

determined by the designer. The keys are stored in the FPGA by JTAG instruction and retained by a battery connected to the VBATT pin, when the device is not powered. Virtex-II Pro devices can be configured with the corresponding encrypted bitstream, using any of the configuration modes described previously. A detailed description of how to use bitstream encryption is provided in the *Virtex-II Pro Platform FPGA User Guide*.

Chapter 6

Board Hardware

1 Introduction to the Board

ET6000K10S Logic Emulation board provides for a comprehensive collection of peripherals to use in creating a system around the Virtex-II Pro FPGA. Figure 24 is a block diagram of the ET6000K10S Logic Emulation board.

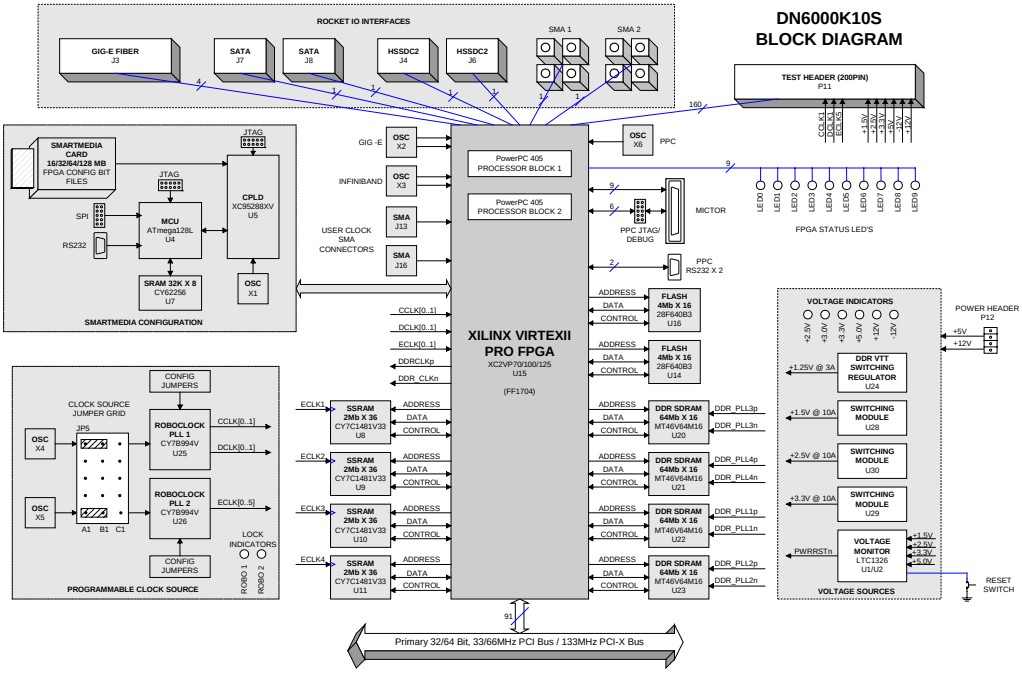


Figure 24 - ET6000K10S Block Diagram

1.1 ET6000K10S Functionality

The components and interfaces featured on the ET6000K10S includes:

- 2VP70-5,-6,-7 or 2VP100-5,-6 Virtex-II Pro FPGA Options

- Flexible and Configurable Clocking Scheme
- SmartMedia Configuration
- DDR SDRAM, 16M x 16
- Synchronous SRAM, 512K x 32/ 36
- FLASH, 4M x 16
- Primary 32/64 Bit, 33/66MHz PCI Bus / 133MHz PCI-X Bus
- 10Gbit Ethernet Fiber Interface (optional)
- Two Infiniband/HSSDC_2 Interfaces
- Two SATA Interfaces
- Two Multi-Gigabit Ttransceiver (MGT) channels (SMA)
- One User Clock SMA Interface (differential)
- 200 Pin Test Header
- CPU Debug and Trace Interfaces, in Berg and Mictor connectors

NOTE: RocketIO interface speed is directly affected by the speed grade of the part. Please refer to the Xilinx datasheet.

2 Virtex-II Pro FPGA

The Virtex-II Pro FPGA is situated on the topside of the board. For a detailed description of the capabilities of the Virtex-II Pro FPGA, refer to the datasheet on the Xilinx website.

2.1 FPGA (2VP70) Facts

The Virtex-II Pro Platform FPGA on board the ET6000K10S is a FPGA in the FF1704 package. The capabilities of the 2VP70 (base model) include:

- 2 PowerPC™ 405 processor
- 16 or 20 Multi-Gigabit Transceivers (MGTs)

- 996 SelectI/O
- 8 Digital Clock Managers (DCMs)
- ~33000 logic slices
- ~5900 Kbits of block SelectRAM (BRAM)
- 328 18 x 18-bit multiplier blocks

The FF1704 package for the FPGA that is used on the ET6000K10S is a 1.0mm (42.5 x 42.5mm) fully populated (with four corner balls removed) flip chip BGA.

The PowerPC™ 405 is capable of operation at 300+ MHz, and is capable of 420+ Dhrystone MIPs (dependend on the speed grade of the part). Each of the MGTs are capable of 3.125 Gigabits per second in both directions, for an aggregate bandwidth of 50 Gigabits per second from the MGTs (25 Gbps transmit and 25 Gbps receive). The SelectIO are capable of supporting multiple high-speed I/O standards, from LVDS to SSTL2 to PCI. The DCMs are capable of 24 MHz to 420 MHz operation and provide for clock deskew, frequency synthesis, and fine phase shifting.

2.2 FPGA Bankout Diagram

The FPGA is connected, directly or indirectly, to all other devices on the board. Figure 25 shows the connections to the FPGA on a ***per bank*** basis.

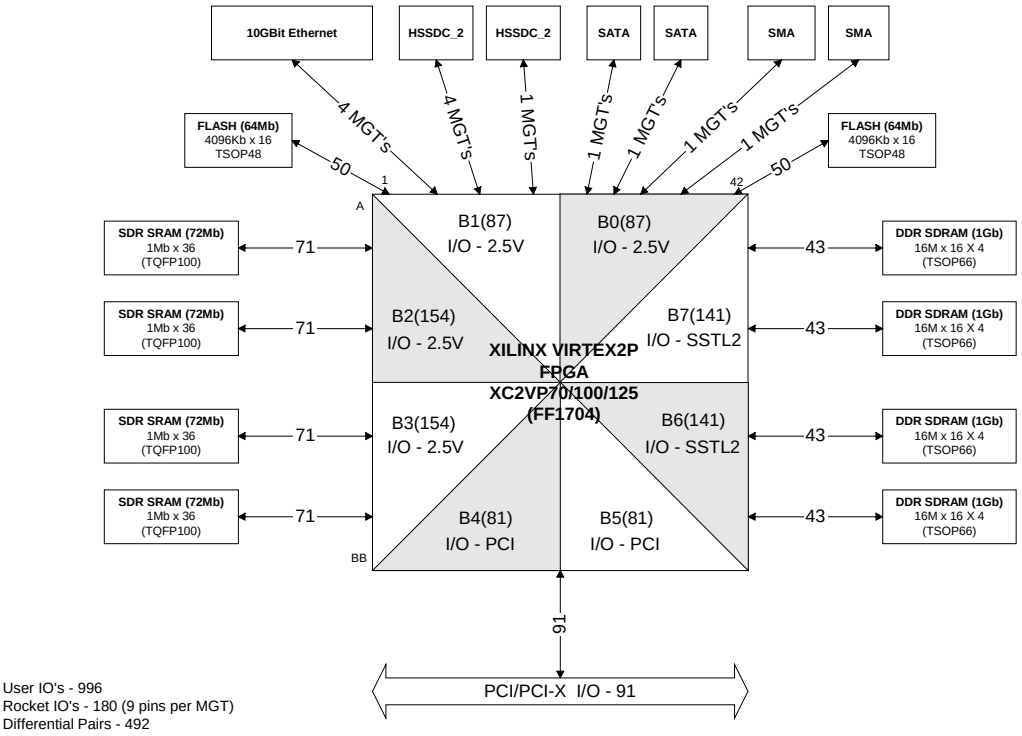


Figure 25 - Bankout Diagram

3 FPGA Configuration

Emulation Technology developed the SmartMedia Configuration Environment to address the need for a space-efficient, pre-engineered, high-density configuration solution for systems with single or multiple FPGA's. The technology is a groundbreaking in-system programmable configuration solution that provides substantial savings in development effort and cost per bit over traditional PROM and embedded solutions for high-capacity FPGA systems.

Virtex-II Pro devices are configured by loading application-specific configuration data into internal memory. Configuration is carried out using a subset of the device pins, some of which are dedicated, while others can be reused as general-purpose inputs and outputs after configuration is complete. SmartMedia is the primary means of configuring the FPGA on the ET6000K10S board. Configuration of FPGA is accomplished using either Serial/SelectMAP or the JTAG interface. The remainder of this section describes the functional blocks that entail the FPGA configuration environment.

3.1 Micro Controller Unit (MCU)

The Atmel ATmega128L (U4) micro controller is used to control the configuration process. The ATmega128L provides the following features: 128K bytes of In-System

Programmable Flash with Read-While-Write capabilities, 4K bytes EEPROM, 4K bytes SRAM, 53 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), four flexible Timer/Counters with compare modes and PWM, 2 USARTs, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain, programmable Watchdog Timer with Internal Oscillator, an SPI serial port, IEEE std. 1149.1 compliant JTAG test interface, also used for accessing the On-chip Debug system and programming and six software selectable power saving modes.

The micro controller interfaces to the CPLD (U5) via an 8-bit bus and the SmartMedia interfaces to the CPLD via an 8-bit bus. The FPGA interfaces to the CPLD via the JTAG interface and an 8-bit bus, used during Serial and SelectMap programming of the FPGA. The amount of internal SRAM (4 Kbytes) is not large enough to hold the FAT needed for SmartMedia, so an external 32K x 8 SRAM (U7) was added. The micro controller is programmed in-system via the serial programming interface (SPI).

The micro controller has the following responsibilities:

- Reading the SmartMedia card
- Configuring the Virtex-II Pro FPGA
- Executing ET6000K10S self tests.

Other than FPGA configuration, the micro controller has no other function. Less than half of the 128KB of FLASH is used for FPGA configuration and utilities, so the user is welcome to utilize the rest of the resources of the micro controller for their own applications. Instructions for customizing the micro controller are contained in the file Atmega128L datasheet (please reference CD-ROM or contact Atmel).

3.1.1 MCU General Purpose IO (GPIO)

Header (P2) as shown in Figure 26 allows for connection to the unused MCU IO pins. The user can utilize this IO as required, e.g. external interrupts, external IO expansion etc. Note: The interface is LVTTL33 and the device is not 5V tolerant.

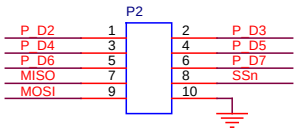


Figure 26 - MCU General Purpose IO Connector

3.1.2 MCU JTAG Interface

The ATMega128L micro controller has a JTAG interface that can be used for on-chip debugging, real-time emulation, and programming of FLASH, EEPROM, fuses, and Lock Bits. In order to take advantage of the JTAG interface, you must have the Atmel

AVR JTAG ICE kit (part number ATAVRJTAGICE) and AVR studio software that Atmel provides free at www.atmel.com. The JTAG interface for the ATmega128L can be accessed through four pins (TCK, TMS, TDO and TDI) on header P3. Header (P3) as shown in Figure 27 allows for connection to the MCU JTAG pins.

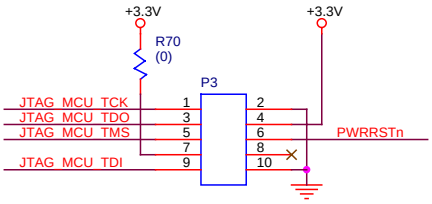


Figure 27 - MCU JTAG Connector

3.1.3 MCU Programming Connector

A programming cable for the ATmega128L is shipped with the ET6000K10S and mates to the MCU programming header (P1) as shown in Figure 28. The programming header is used to download the files to the MCU using the AVR In-System Programming Cable.

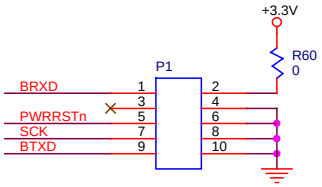


Figure 28 - MCU Programming Connector

3.1.4 RS232 Interface

An RS232 serial port (P5) is provided for low speed communication with the MCU. The RS-232 standard specifies output voltage levels between -5 to -15 Volts for logical 1 and +5 to +15 Volts for logical 0. Input must be compatible with voltages in the range of -3V to -15V for logical 1 and +3V to +15V for logical 0. This ensures data bits are read correctly even at maximum cable lengths between DTE and DCE, specified as 50 feet.

The RS-232 standard has two primary modes of operation, Data Terminal Equipment (DTE) and Data Communication Equipment (DCE). These can be thought of as host or PC for DTE and as peripheral for DCE. The ET6000K10S operates in the DCE mode only.

Figure 29 shows the implementation of the serial port on the ET6000K10S

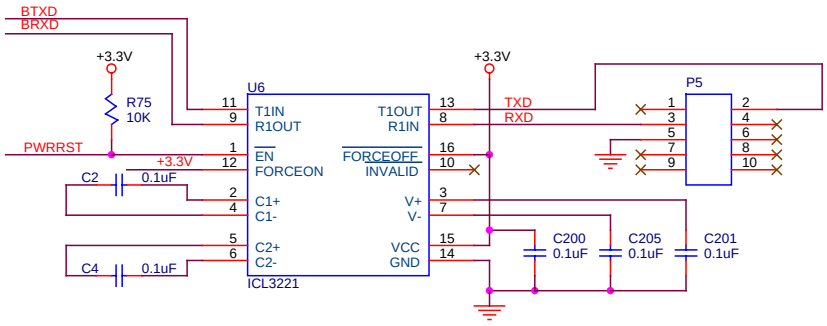


Figure 29 - MCU Serial Port

There are two signals attached to the MCU:

- Transmit Data
- Receive Data

TXD and RXD provide bi-directional transmission of transmit and receive data. No hardware handshaking is supported.

3.2 CPLD

The Xilinx XC95288XV (U5) CPLD is needed to handle the counters and state machines associated with the high-speed interface to the SmartMedia card. Approximately 90% of the resources of this device are utilized, so 10% are available to the user. The Verilog source code for the CPLD (CPLD.V) is provided on the CD-ROM.

The CPLD performs the following functions:

- Interface to the Micro Controller
  - Data Bus: UPAD[0..7]
  - Control Signals: UP_RDn, UP_WRn, UP_ALE
  - Clock: MCU_CLK
- Interface to the SmartMedia
  - Data Bus: SM_D[0..7]
  - Control Signals: SM_REn, SM_WEn, SM_ALE, SM_CLE, SM_CEn, SM_RDYBUSYn
- FPGA Configuration, Serial/SelectMap
  - Data Bus: FPGA_D[0..7]

  - Control Signals: FPGA_BUSY, FPGA_RD/WRn, FPGA_CSn, FPGA_DONE, FPGA_INITn, FPGA_PROGn
  - Clock: FPGA_DCLK
- FPGA Configuration, JTAG
  - JTAG Signals: FPGA_TCK, FPGA_TDI, FPGA_DONE/TDO, FPGA_TMS
- SRAM Chip Select Generation
  - Signal: SRAM_CSn
- FPGA Configuration MODE Select DipSwitch
  - Signals: FPGA_MSEL[0..3]
- LED Indicators
  - Signals: CPLD_LEDn[0..3]
- GPIO to FPGA
  - Signals: FPGA_GPIO[0..7]

3.2.1 CPLD Programming Connector

A programming cable for the XC95288XV is shipped with the ET6000K10S. The CPLD programming header (P7) as shown in Figure 30, is used to download the files to the CPLD using the XILINX JTAG cable.

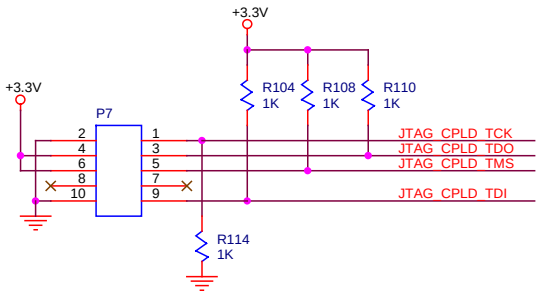


Figure 30 - CPLD Programming Header

3.2.2 Design Notes on the CPLD

Oscillator (X1) is a 48 MHz oscillator used to clock the CPLD. This part is soldered down to the PWB and is not intended to be user-configurable. The 48 MHz is divided down to 8 MHz in the CPLD to provide the clock for the micro controller (U4). The clock signal is labeled MPU_CLK on the schematic.

The 48 MHz is used directly for the state machines in the CPLD for controlling the interface to the SmartMedia card. The frequency of 48 MHz is interesting because it is the closest frequency to 50 MHz that can be divided by an integer to get 8 MHz. The

frequency 50 MHz is the fastest that the Virtex-II Pro parts can be configured with SelectMap without wait states. So FPGA configuration using SelectMap occurs at very nearly the fastest theoretical speed.

Serial and JTAG configuration of the Virtex-II Pro FPGA's are back-off positions only. The 48 MHz clock can be divided down in the CPLD and used as a clock source to the PWB clock network (CPLD_CLKOUT).

The signals FPGA_GPIO[0..7] are general purpose IO connections between the CPLD and the FPGA.. ROBO_LOCK[1..2] Indicates that the RoboClock (U25,U26) PLL's are locked. FPGA_MSEL[0..3] selects the configuration mode of the FPGA (refer to Table 9).

Table 9 - FPGA Configuration Modes

Configuration Mode	M2	M1	M0	CLK Direction	Data Width	Serial Dout
Master Serial	0	0	0	Out	1	Yes
Slave Serial	1	1	1	In	1	Yes
Master SelectMAP	0	1	1	Out	8	No
Slave SelectMAP	1	1	0	In	8	No
Boundary Scan	1	0	1	N.A.	1	No

Note: Grayed options not supported by this design.

3.3 SmartMedia

The configuration bit file for the FPGA is copied to a SmartMedia card using the SmartDisk FlashPath Floppy Disk Adapter. The approximate file size for each possible FPGA option is shown below in Table 10. Note that several BIT files can be put on a 32MB card. The ET6000K10S is shipped with two 32-megabyte 3.3V SmartMedia cards. The ET6000K10S support card densities up to 128MB.

Note: Do **NOT** format the SmartMedia card using the default Windows file format program. Smart Media cards come pre-formatted from the factory, and files can be deleted from the card when they are no longer needed. If the SmartMedia card requires formatting, format the media with the program supplied by the FlashPath (SmartMedia floppy adapter) software.

Table 10 - FPGA configuration file sizes

Virtex-II Pro	Bitstream

Device	Length (bits)
XC2VP70	25,604,096
XC2VP100	33,645,312

SmartMedia Cards are available from www.computers4sure.com

3.3.1 SmartMedia Connector

Figure 31 shows J1, the SmartMedia connector used to download the configuration files to the FPGA.

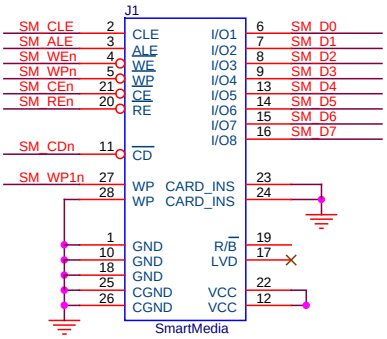


Figure 31 - SmartMedia Connector

Note: Do not press down on the top of the SmartMedia connector J1 if a SmartMedia card is not installed. The metal case shorts +3.3V to GND.

3.3.2 SmartMedia connection to CPLD/MCU

Table 11 shows the connection between the SmartMedia connector and the CPLD/MCU.

Table 11 - Connection between CPLD/MCU

Signal Name	CPLD/MPU	Connector
SM_D0	U5.26	J1.6
SM_D1	U5.27	J1.7
SM_D2	U5.28	J1.8
SM_D3	U5.31	J1.9
SM_D4	U5.33	J1.13
SM_D5	U5.34	J1.14
SM_D6	U5.35	J1.15

Signal Name	CPLD/MPU	Connector
SM_D7	U5.39	J1.16
SM_CLE	U5.20	J1.2
SM_ALE	U5.21	J1.3
SM_WEn	U5.22	J1.4
SM_RDYBUSYn	U5.40	J1.19
SM_WPn	U5.23	J1.5
SM_CEn	U5.24	J1.21
SM_REn	U5.25	J1.20
SM_CDn	U4.8	J1.11
SM_WP1n	U4.61	J1.27

3.4 Boundary-Scan (JTAG, IEEE 1532) Mode

In boundary-scan mode, dedicated pins are used for configuring the Virtex-II Pro device. The configuration is done entirely through the IEEE 1149.1 Test Access Port (TAP). The FPGA JTAG interfaces to IO on the CPLD. This allows manipulation of the data as required by the application and allows the JTAG chain to become an address on the existing bus. The processor can then read from, or write to the address representing the JTAG chain.

3.4.1 FPGA JTAG Connector

Figure 32 shows P6, the JTAG connector used to download the configuration files to the FPGA.

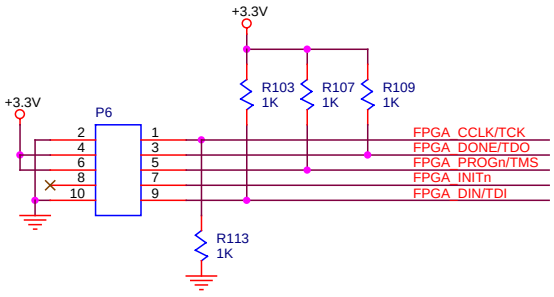


Figure 32 - FPGA JTAG Connector

3.4.2 FPGA JTAG connection to CPLD

Table 12 shows the connection between the FPGA JTAG connector and the CPLD.

Table 12 - FPGA JTAG connection to CPLD

Signal Name	CPLD	Connector
DCLK/TCK	U5.11	P6.1
DONE/TDO	U5.12	P6.3
INITn/TMS	U5.13	P6.5
DATA0/TDI	U5.14	P6.9

4 Clock Generation

4.1 Clock Methodology

The ET6000K10S Logic Emulation board has a flexible and configurable clocking scheme. Figure 33 is a block diagram showing the clocking resources and connections.

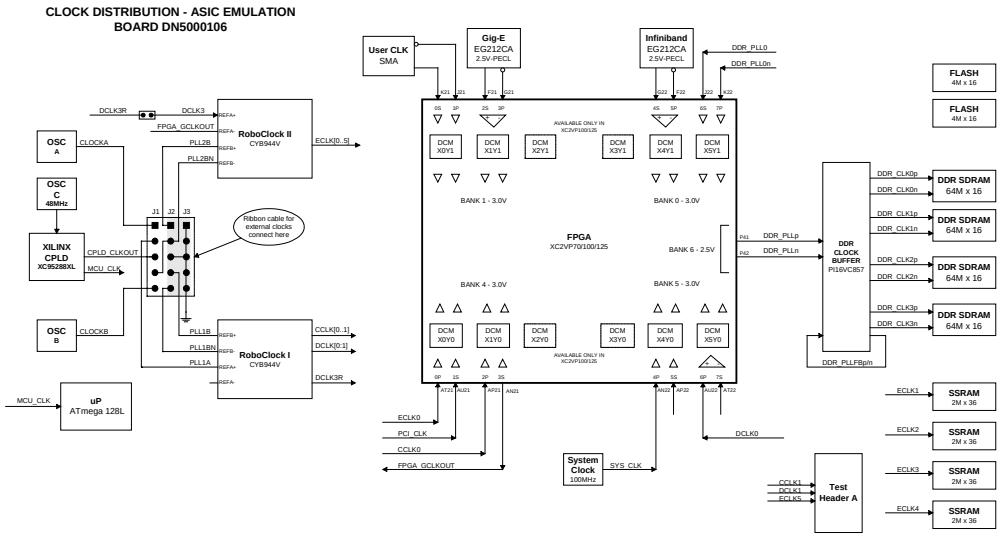


Figure 33 - Clocking Block Diagram

The clocking structures for the ET6000K10S include the following features:

- Two user-selectable socketed oscillators (X4, X5)
- One 48 MHz oscillator (X1)
- Two RoboclockII™ (CY7B994V) Multi-Phase PLL Clock Buffers

The clock source selection grid formed by JP5, distributes clock signals to two Roboclock PLL clock buffers (U25, U26). The clock outputs from the buffers are dispersed throughout the board.

Two 3.3 V half-can oscillator sockets (X4, X5) and the signal CPDL_CLKOUT from the CPLD provide on-board input clock solutions. The ET6000K10S is shipped with both a 14.318 MHz (X4) and a 33.33 MHz (X5) oscillator.

Neither X4 nor X5 are used by the configuration circuitry, so the user is free to stuff any standard 3.3 V half-can oscillators in the X4 and X5 positions. The Clock Grid can also accept a 5X2 ribbon cable. This cable can provide input clocks to the Roboclocks. The two Roboclocks offer functional control of clock frequency and skew, among other things. The two Roboclocks PLL clock buffers (U25 and U26) are configured via header arrays JP6, JP7, JP8. The ET6000K10S is factory stuffed with CYB994V, which can operate at frequencies from 24 MHz to 200 MHz respectively.

Each chip has 16 output clocks along with two feedback output clocks. Two sets of eight output clocks are jumper selectable for each chip. The feedback clocks are controlled separately. The PLL clock buffers can accept either LVTTL33 or Differential (LVPECL) reference inputs (refer to Figure 34). The devices can operate at up to 12x the input frequency while the output clocks can be divided up to 12x the operating frequency.

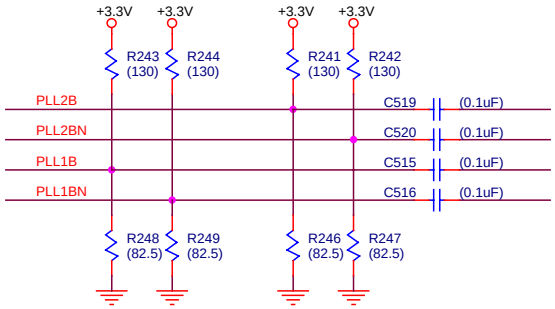


Figure 34 - LVPECL Clock Input and Termination

Note: The schematic shows capacitors in locations C519, C520, C515, C516. These are actually populated with 0-ohm resistors for direct connection to the RoboClock reference inputs. The terminating resistors to GDN and +3.3V are not stuffed. When using LVPECL, make the required hardware changes.

The connections between the FPGA and various clocking resources are documented in Table 13, covering the clocking inputs and outputs, respectively.

Table 13 - Clocking inputs to the FPGA

Signal Name	FPGA Pin	Clock Refdes and Pin
CLK_USERn	J21	J13
CLK_USERp	K21	J16
Gig-E_OSCp	F21	X2
Gig-E_OSCn	G21	X2
Infin_OSCp	G22	X3
Infin_OSCn	F22	X3
DDR_PLL0	J22	U27
DDR_PLL0n	K22	U27
CCLK0	AP21	U25
DCLK0	AU22	U25
ECLK0	AT21	U26
PCI_CLK	AU21	P4
SYS_CLK	AN22	X6
FPGA_GCLKOUT	AN21	U15

4.2 Clock Source Jumpers

The clock source grid JP5 gives the user the ability to customize the clock scheme on the ET6000K10S. A brief description of each pin is given in Table 14.

Table 14 - Clock Source Signals

Signal Name	Description	Connector
CPLD_CLKOUT	Clock signal from the CPLD.	JP5.A3
CLOCKA	Clock signal from oscillator X4	JP5.A1
CLOCKB	Clock signal from oscillator X5	JP5.A5
PLL1B	Secondary clock input to RoboClock, differential pair with PLL1BN	JP5.B4
PLL1BN	Secondary clock input to RoboClock, differential pair with1 PLL1B	JP5.B5
PLL2B	Secondary clock input to RoboClock, differential pair with PLL2BN	JP5.B1
PLL2BN	Secondary clock input to RoboClock,	JP5.B2

Signal Name	Description	Connector
	differential pair with PLL2BN	
GND	Provides a ground reference for signals in the ribbon cable.	

4.2.1 Clock Source Jumper Header

Figure 35 shows JP5, the clock source header connector used to select between different clock sources.

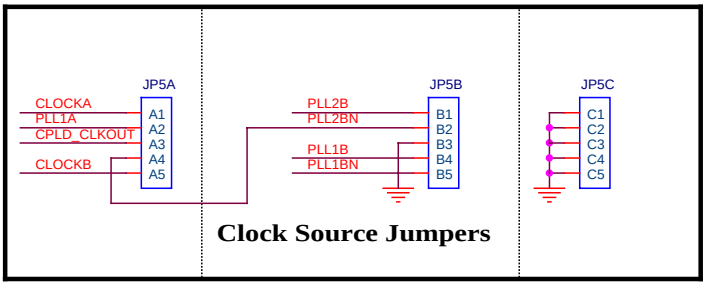


Figure 35 - Clock Source Jumper

4.3 External Clocks

The clock source jumper allows the user a simple means to attach external clocks to the clock grid. The user can attach 10-pin ribbon cable to JP5B/C, which allows for connection the differential pair inputs of both RoboClocks. JP5C ground pins for signal integrity. These signals are described in Table 14. Both differential pairs provide some flexibility. The user can bring a single 3.3V TTL input. It can be attached to either input. However, the other input must be left open. The user can provide a differential clock input to the pair to the RoboClocks.

4.4 Common Clock Source Selections

The following configuration is the most common:

Configuration 1: CLOCKA → PLL1A, CLOCKB → PLL2BN

RoboClock #1 (U25) is driven from oscillator X4, RoboClock #2 (U26) is driven from oscillator X5. RoboClock #2 can also be driven from RoboClock #1 output (DCLK3) it required.

4.5 RoboClock PLL Clock Buffers

The CY7B994V (U25, U26) High-Speed Multi-Phase PLL Clock Buffers offer user-selectable control over system clock functions.

Eighteen configurable outputs each drive terminated transmission lines with impedances as low as 50 while delivering minimal and specified output skews at LVTTL levels (refer to Figure 36). The outputs are arranged in five banks. Banks 1 to 4 of four outputs allow a divide function of 1 to 12, while simultaneously allowing phase adjustments in 625 ps - 1300 ps increments up to 10.4 ns. One of the output banks also includes an independent clock invert function. The feedback bank consists of two outputs, which allows divide-by functionality from 1 to 12 and limited phase adjustments. Any one of these eighteen outputs can be connected to the feedback input as well as driving other inputs.

Selectable reference input is a fault tolerance feature, which allows smooth change over to secondary clock source, when the primary clock source is not in operation. The reference inputs and feedback inputs are configurable to accommodate either LVTTL or Differential (LVPECL) inputs. The completely integrated PLL reduces jitter. Please refer to the datasheet for more detailed information.

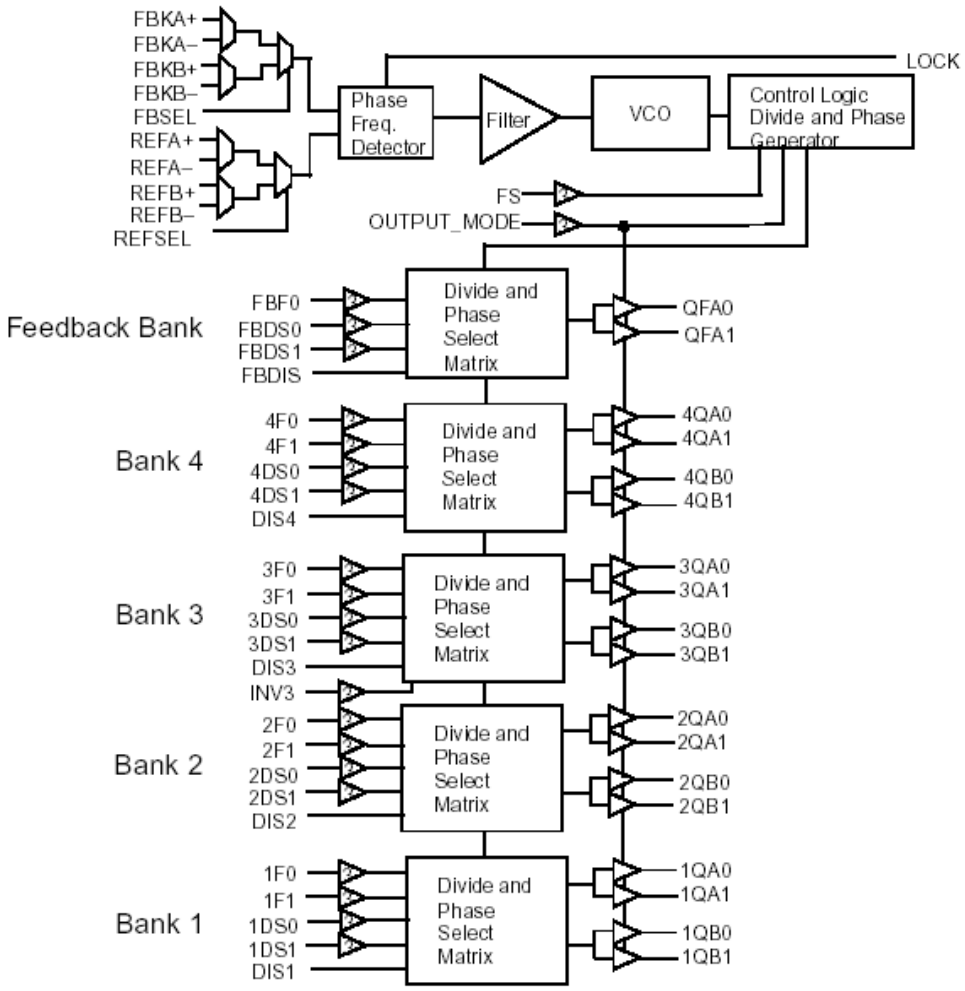


Figure 36 - RoboClock Functional Block Diagram

4.5.1 RoboClock Configuration Jumpers

Header JP6, JP7, and JP8 enable the user to configure the RoboClocks as required. These are 3-way headers and allow the signal to float (MID), or be pulled to GND (LOW) or +3.3V (HIGH). A brief description of each pin is given in Table 15.

Table 15 - RoboClock Configuration Signals

Signal Name	Description	Connector
RBCF0	Output Phase Function Select: Controls the phase function of bank 3 & 4 (CCLK) of outputs, refer to Table 3 in the datasheet.	JP6.B1
RBCF1	Output Phase Function Select: Controls the phase function of bank 3 & 4 (CCLK) of outputs, refer to Table 3 in the datasheet.	JP6.B2

Signal Name	Description	Connector
CDS0	ROBOCLOCK #1, Output Divider Function Select: Controls the divider function of bank 3 & 4 (CCLK) of outputs. Refer to Table 4 in the datasheet.	JP6.B3
CDS1	ROBOCLOCK #1, Output Divider Function Select: Controls the divider function of bank 3 & 4 (CCLK) of outputs. Refer to Table 4 in the datasheet.	JP6.B4
RBDF0	ROBOCLOCK #1, Output Phase Function Select: Controls the phase function of bank 1 & 2 (DCLK) of outputs. Refer to Table 3 in the datasheet.	JP6.B5
RBDF1	ROBOCLOCK #1, Output Phase Function Select: Controls the phase function of bank 1 & 2 (DCLK) of outputs. Refer to Table 3 in the datasheet.	JP6.B6
DDS0	ROBOCLOCK #1, Output Divider Function Select: Controls the divider function of bank 1 & 1 (DCLK) of outputs. Refer to Table 4 in the datasheet.	JP6.B7
DDS1	ROBOCLOCK #1, Output Divider Function Select: Controls the divider function of bank 1 & 1 (DCLK) of outputs. Refer to Table 4 in the datasheet.	JP6.B8
FS1	ROBOCLOCK #1, Frequency Select: This input must be set according to the nominal frequency (fNOM). Refer to Table 1 in the datasheet.	JP7.B1
FBF01	ROBOCLOCK #1, Feedback Output Phase Function Select: This input determines the phase function of the Feedback Bank's QFA[0:1] outputs. Refer to Table 3 in the datasheet.	JP7.B2
FBDS01	ROBOCLOCK #1, Feedback Divider Function Select: These inputs determine the function of the QFA0 and QFA1 outputs. Refer to Table 4 in the datasheet.	JP7.B3
FBDS11	ROBOCLOCK #1, Feedback Divider Function Select: These inputs determine the function of the QFA0 and QFA1 outputs. Refer to Table 4 in the	JP7.B4

Signal Name	Description	Connector
	datasheet.	
FS2	ROBOCLOCK #2, Frequency Select: This input must be set according to the nominal frequency (fNOM). Refer to Table 1 in the datasheet.	JP7.B5
FBF02	ROBOCLOCK #2, Feedback Output Phase Function Select: This input determines the phase function of the Feedback Bank's QFA[0:1] outputs. Refer to Table 3 in the datasheet.	JP7.B6
FBDS02	ROBOCLOCK #2, Feedback Divider Function Select: These inputs determine the function of the QFA0 and QFA1 outputs. Refer to Table 4 in the datasheet.	JP7.B7
FBDS12	ROBOCLOCK #2, Feedback Divider Function Select: These inputs determine the function of the QFA0 and QFA1 outputs. Refer to Table 4 in the datasheet.	JP7.B8
OSCA	Enable for Oscillator A (X4)	JP7.B9
OSCB	Enable for Oscillator B (X5)	JP7.B10
REFSEL1	ROBOCLOCK #1, Reference Select Input: The REFSEL input controls how the reference input is configured. When LOW, it will use the REFA pair (PLL1A) as the reference input. When HIGH, it will use the REFB pair (PLL1BC, PLL1BNC) as the reference input. This input has an internal pull-down.	JP8.B1
REFSEL2	ROBOCLOCK #2, Reference Select Input: The REFSEL input controls how the reference input is configured. When LOW, it will use the REFA pair (DCLK3 or FPGA_CLKOUT) as the reference input. When HIGH, it will use the REFB pair (PLL2BC or PLL2BNC) as the reference input. This input has an internal pull-down.	JP8.B2
MODE1	ROBOCLOCK #1, Output Mode: This pin determines the clock outputs' disable state. When this input is HIGH, the clock outputs will disable to high-impedance (HI-Z). When this input is LOW, the clock outputs will disable to "HOLD-OFF" mode. When in MID, the device will enter	JP8.B3

Signal Name	Description	Connector
	factory test mode.	
MODE2	ROBOCLOCK #2, Output Mode: This pin determines the clock outputs' disable state. When this input is HIGH, the clock outputs will disable to high-impedance (HI-Z). When this input is LOW, the clock outputs will disable to "HOLD-OFF" mode. When in MID, the device will enter factory test mode.	JP8.B4
FBDIS1	ROBOCLOCK #1, Feedback Disable: This input controls the state of QFA[0:1]. When HIGH, the QFA[0:1] is disabled to the "HOLD-OFF" or "HI-Z" state; the disable state is determined by OUTPUT_MODE. When LOW, the QFA[0:1] is enabled. Refer to Table 5 in the datasheet. This input has an internal pull-down.	JP8.B5
FBDIS2	ROBOCLOCK #1, Feedback Disable: This input controls the state of QFA[0:1]. When HIGH, the QFA[0:1] is disabled to the "HOLD-OFF" or "HI-Z" state; the disable state is determined by OUTPUT_MODE. When LOW, the QFA[0:1] is enabled. Refer to Table 5 in the datasheet. This input has an internal pull-down.	JP8.B6
RBEF0	ROBOCLOCK #2, Output Phase Function Select: Controls the phase function of bank 1, 2, 3 & 4 (ECLK) of outputs. Refer to Table 3 in the datasheet.	JP8.B7
RBEF1	ROBOCLOCK #2, Output Phase Function Select: Controls the phase function of bank 1, 2, 3 & 4 (ECLK) of outputs. Refer to Table 3 in the datasheet.	JP8.B8
EDS0	ROBOCLOCK #2, Output Divider Function Select: Controls the divider function of bank 1, 2, 3 & 4 (ECLK) of outputs. Refer to Table 4 in the datasheet.	JP8.B9
EDS1	ROBOCLOCK #2, Output Divider Function Select: Controls the divider function of bank 1, 2, 3 & 4 (ECLK) of outputs. Refer to Table 4 in the datasheet.	JP8.B10

4.5.2 Clock Source Jumper Header

Figure 37 shows JP6, JP7, and JP8, the RoboClock configuration jumpers.

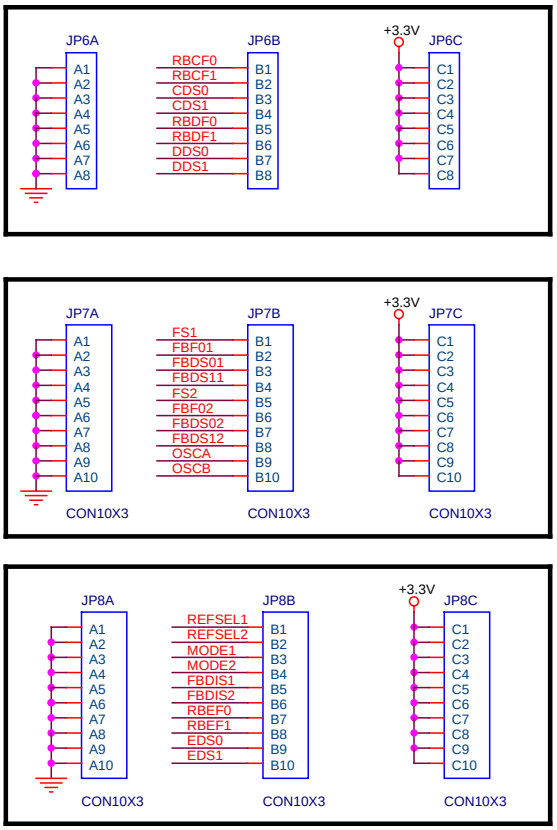


Figure 37 - RoboClock Configuration Jumpers

4.5.3 Useful Notes and Hints

The RoboClock consistently outputs ~32.5MHz signals in cases of improper settings or unacceptable clock inputs. This was observed when the CY7B994V part was operating at a nominal frequency f_{NOM} of 36.4MHz with FS set LOW. Identical clocks were sent to PLL2B and PLL2BN.

For the CY7B994V part, the operating frequency can reach up to 200 MHz. However, the maximum output frequency is 185MHz. This means when 185 MHz < f_{NOM} < 200MHz, the output divider must be set to at least 2. Otherwise, the RoboClocks will output garbage.

4.5.4 Customizing the Oscillators

The user can customize the frequency of the clock networks by stuffing different oscillators in X4 and X5. The ET6000K10S is shipped with a 14.318MHz oscillator in location X4 and a 33.333MHz oscillator in X5. The RoboClocks are not +5V tolerant, so +3.3V oscillators are necessary.

Emulation Technology suggests Digi-Key (http://www.digikey.com/) as a possible source for the oscillators. Of note is the Epson line of oscillators called the SG-8002 Programmable Oscillators. Any frequency between 1.00MHz–106.25MHz can be procured in the normal Digi-Key shipping time of 24 hours. A half-can, +3.3 V CMOS version is needed with a tolerance of 50ppm. The part number for an acceptable oscillator from this family would be:

SG-8002DC-PCB-ND

- Package SG-8002DC (Halfcan)
- Output Enable
- 3.3 V CMOS
- ±±50 ppm

If the order is placed via the web page, the requested frequency to two decimal places is placed in the Web Order Notes. The datasheet is on the CD-ROM for this oscillator. Any polarity of output enabled for each oscillator (on pin 1) is acceptable. Ensure the proper jumper settings for JP7.B9/JP7.B10. See Table 15 for a description.

4.6 DDR Clocking

The DDR Clock is generated in the FPGA by using the Digital Clock Managers (DCM). Clocking for DDR SDRAM requires the transmission of two clocks, the positive clock and the negative clock, SSTL_2 differential. These two clocks are 180° out of phase from each other, and their phase alignment must be tightly controlled. In order to prevent signal integrity problems and timing differences from becoming an issue, it is preferable for each device, whether memory or register, to have its own clock.

While it is possible for each device to have a positive and negative clock generated by the FPGA, this unnecessarily consumes pins that could be used elsewhere. To save these pins, an externally DDR SDRAM clock driver is used. The clock is routed to the DDR PLL Clock Driver (U27) that distributes the individual clocks to the separate DDR devices (U20, U21, U22, and U23).

4.6.1 Clocking Methodology

This section describes the DDR clocking methodology implemented in the reference design (refer to Figure 38). The first DCM generates CLK0 and CLK90. CLK0 directly follows the user-supplied input clock (one of the clock sources, ECLK, PCI_CLK etc.). This DCM also supplies the CLKDV output, which is the input clock divided by 16 used for the AUTO REFRESH counter. The second DCM in the controller block (DCM2_RECAPTURE) generates a phase-shifted version of the user input clock. It is used to recapture data from the DQS clock domain during a memory Read. Data

recaptured in the rclk domain is then transferred to the system clock domain. The phase-shift value is specific to the system and must be programmed accordingly.

When adequate DCM resources are available, a third DCM can be used for better timing margins. This DCM is used to generate WCLK, a phase shifted version of the system clock. WCLK is used to clock data at the DDR IOB registers during a Write.

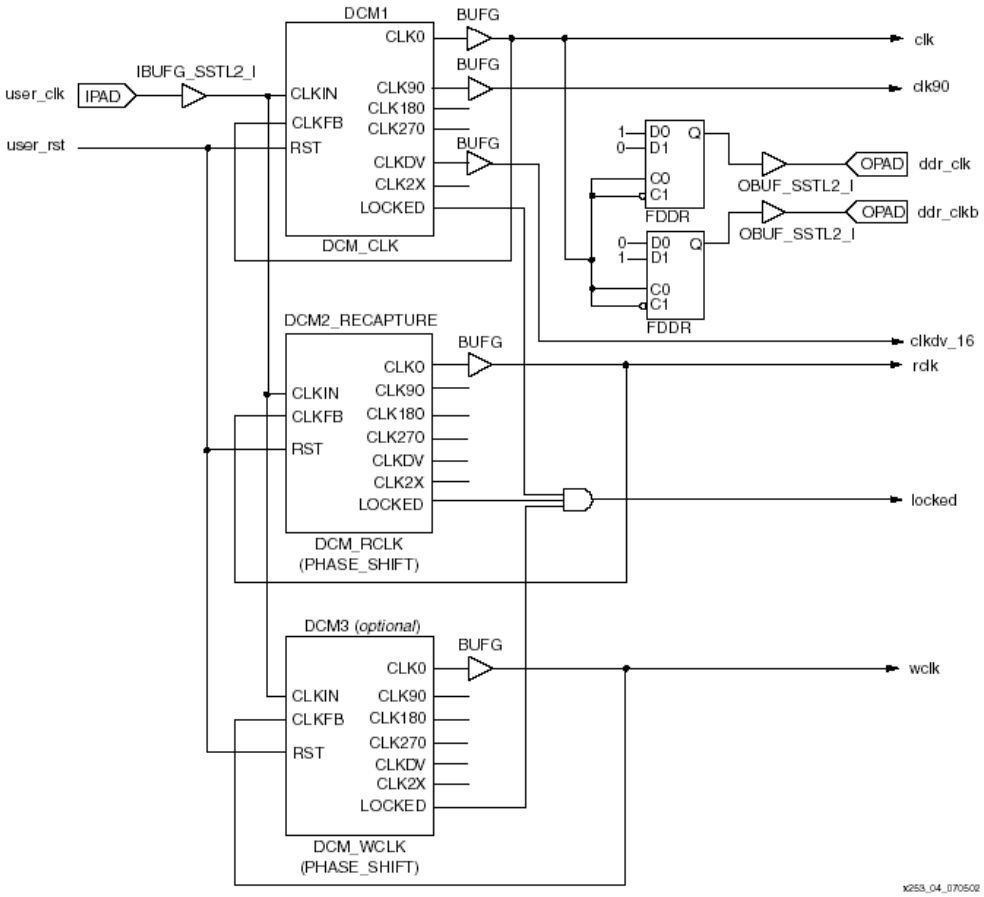


Figure 38 - DDR DCM Implementation

4.6.2 Connections between FPGA and DDR PLL Clock Buffer

The connection between the FPGA and the DDR PLL Clock Driver (U27) consists of a SSTL_2 differential pair. DDR_PLL0 can be used as a feedback reference clock input. The connections are shown in Table 16.

Table 16 - Connection between FPGA and DDR PLL Clock Driver

Signal Name	FPGA Pin	DDR PLL Clock Driver (U27)
DDR_CLK	U15.P41	U27.13

DDR_CLKn	U15.P42	U27.14
DDR_PLL0	U15.J22	U27.22
DDR_PLL0n	U15.K22	U27.23

4.7 Power PC (PPC) Clock

A 3.3 V half-can oscillator (X6), and the signal SYS_CLK provide an external clock source for the PPC. The oscillator is socketed and the ET6000K10S is shipped with a 100MHz oscillator, refer to Figure 39.

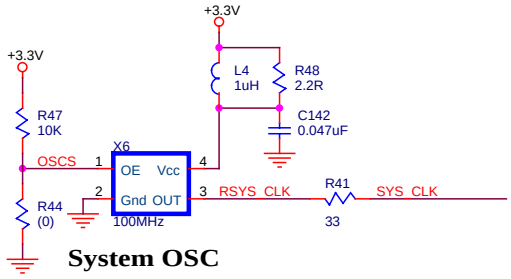


Figure 39 - PPC External Clock

4.7.1 Clocking Methodology

Refer to the Xilinx application notes for more information on this subject.

4.7.2 Connections between FPGA and DDR PLL Clock Buffer

The connection between the FPGA and the external oscillator are shown in Table 17.

Table 17 - Connection between FPGA and External PPC Oscillator

Signal Name	FPGA Pin	DDR PLL Clock Driver (U27)
SYS_CLK	U15.AN22	X6.3

4.8 Rocket IO Clocks

The ET6000K10S provides two oscillators, one for Gigibit Ethernet (X2) and the other for Infiniband (X3). There are eight clock inputs into each RocketIO transceiver instantiation. REFCLK and BREFCLK are reference clocks generated from an external sources and presented to the FPGA as differential inputs. The reference clocks connect to the REFCLK or BREFCLK ports of the RocketIO multi-gigabit transceiver (MGT). While only one of these reference clocks is needed to drive the MGT, BREFCLK or BREFCLK2 must be used or serial speeds of 2.5 Gbps or greater. The reference clock also locks a Digital Clock Manager (DCM) or a BUFG to

generate all of the other clocks for the GT. *Never run a reference clock through a DCM, since unwanted jitter will be introduced.*

4.8.1 Clocking Methodology

At speeds of 2.5 Gbps or greater, REFCLK configuration introduces more than the maximum allowable jitter to the RocketIO transceiver. For these higher speeds, BREFCLK configuration is required. The BREFCLK configuration uses dedicated routing resources that reduce jitter. BREFCLK must enter the FPGA through dedicated clock I/O. BREFCLK can connect to the BREFCLK inputs of the transceiver and the CLKIN input of the DCM for creation of USRCLKs. For more information refer to the Rocket IO User Guide available from the Xilinx website.

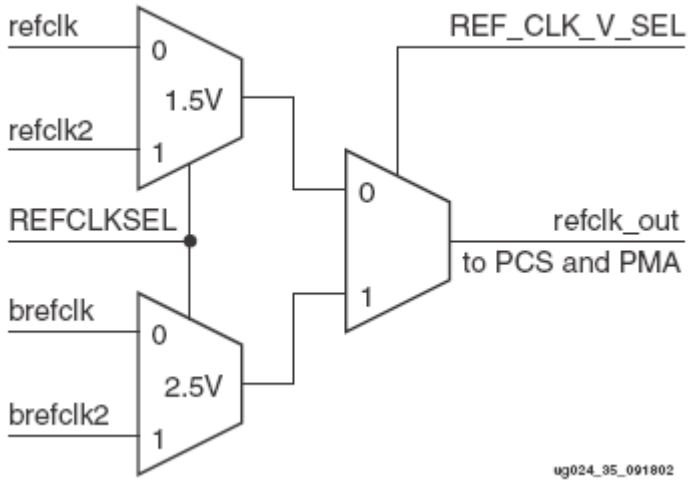


Figure 40 - REFCLK/BREFCLK Selection Logic

4.8.2 Connections between FPGA and DDR PLL Clock Buffer

The connection between the FPGA and the external oscillators are shown in Table 18.

Table 18 - Connections between FPGA and Rocket IO Oscillators

Signal Name	FPGA Pin	OSCILLATOR
GigEp	U15.F21	X2.4
GigEn	U15.G21	X2.5
Infinibandp	U15.G22	X3.4
Infinibandn	U15.F22	X3.5

4.8.3 Reference Clocks

A high degree of accuracy is required from the reference clocks (X2, X3). For this reason, it is required that one of the oscillators listed in this section be used. The ET6000K10S is shipped with the Pletronics parts (Note: the PCB footprint was designed to take either):

Epson EG-2121CA 2.5V (LVPECL Outputs)

See the Epson Electronics America website for detailed information. The circuit shown in Figure 41 must be used to interface the oscillator's LVPECL outputs to the LVDS inputs of the transceiver reference clock. Alternatively, the LVDS_25_DCI input buffer may be used to terminate the signals with on-chip termination, as shown in Figure 42.

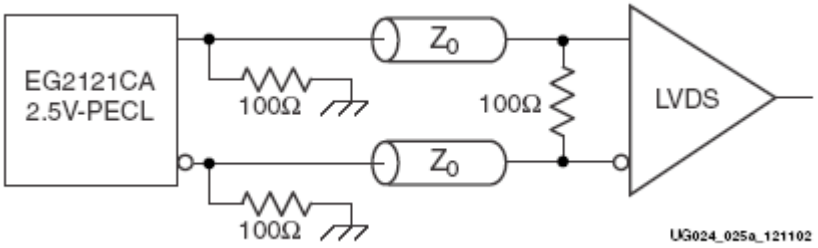


Figure 41 - LVPECL Reference Clock Oscillator Interface

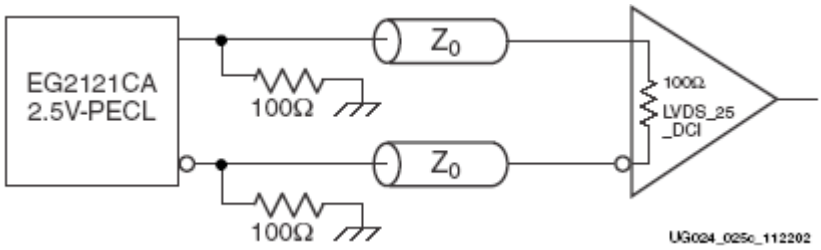


Figure 42 - LVPECL Reference Clock Oscillator Interface (DCI)

Pletronics LV1145B (LVDS Outputs)

See the Pletronics website for detailed information. The circuit shown in Figure 43 must be used to interface the oscillator's LVDS outputs to the LVDS inputs of the transceiver reference clock. Alternatively, the LVDS_25_DCI input buffer may be used to terminate the signals with on-chip termination, as shown in Figure 44.

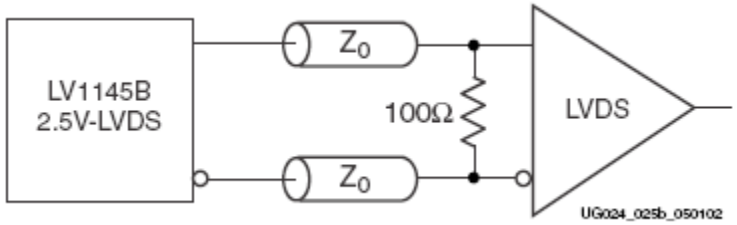


Figure 43 - LVDS Reference Clock Oscillator Interface

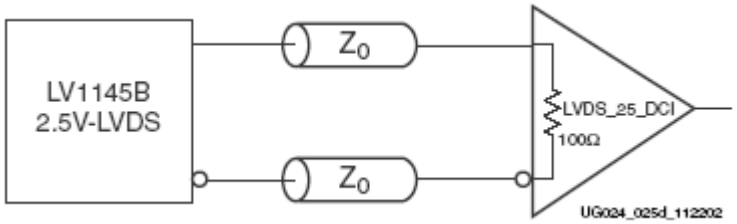


Figure 44 - LVDS Reference Clock Oscillator Interface (DCI)

Note: Depending on weather or not the LVPECL or the LVDS parts is selected, the user must appropriately terminate the differential signals with R126, R127 R128, R140, R141, and R142 to maintain optimum signal integrity.

4.9 External User Clock (SMA)

The SMA connectors (J13, JJ16) allow for direct connection of an external differential clock to the FPGA.

4.9.1 FPGA to SMA Connector

The connection between the FPGA and the SMA connectors is fairly simple, involving only one wire per connector, as well as a few resistors to AC-couple and terminate the signals. The connections are also shown in Table 19.

Table 19 - Connections between FPGA and SMA Connector (CLK)

Signal Name	FPGA Pin	Connector
CLK_USERp	U15.K21	J16
CLK_USERn	U15.J21	J13

5 Reset Topology

5.1 ET6000K10S Reset

The voltage monitor devices from Linear Technology, P/N LTC1326 (U1, U2), allow a push-button reset function that is used to reset the ET6000K10S. Figure 45 shows the distribution of the reset signal PWRRSTn. In addition to controlling the reset, the power supplies rails +1.5V, +2.5V, +3.3V, and +5V are monitored for under-voltage conditions, that will cause the assertion of the PWRRSTn signal.

Momentarily depressing the RESET push-button (S1) causes a narrow 100us soft reset pulse on the signal PWRRSTn. If the reset push-button is depressed for more than 2s and held, PWRRSTn will be asserted continuously. LED DS2.2 when lit, means that reset is asserted, refer the section describing the GPIO LED's.

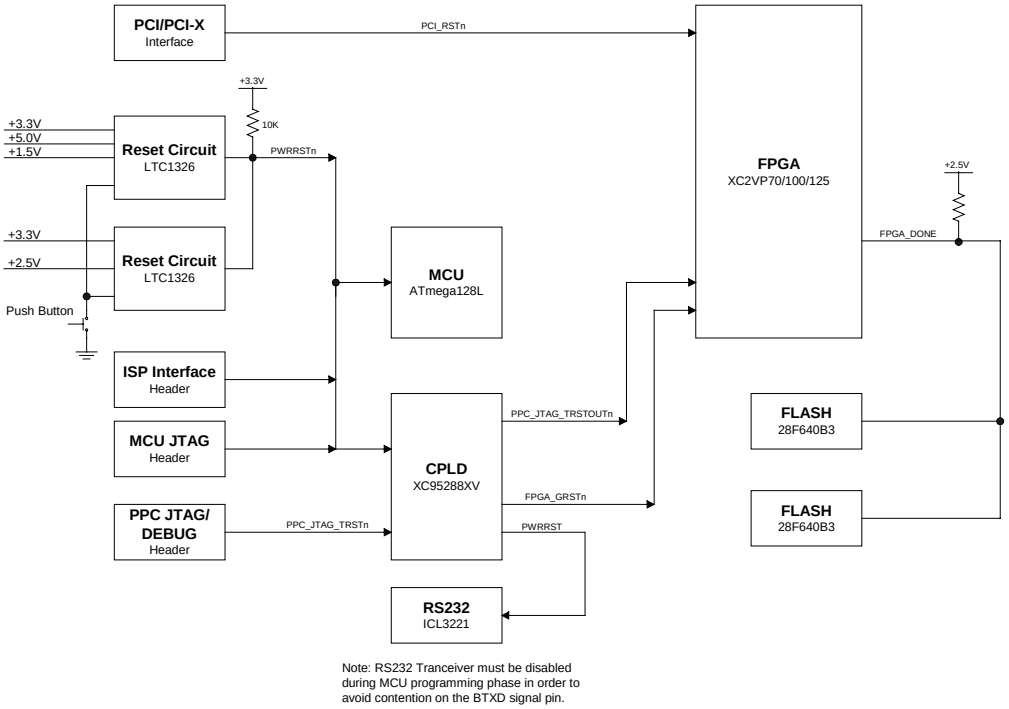


Figure 45 - Reset Topology Block Diagram

Note: The Serial Programming Cable (SPI) when connected to P1 will assert PWRRSTn. The CPLD inverts the PWRRSTn signal to PWRRST that is used to disable the transmitter in the RS232 interface (U6) during programming of the MCU (U4). This is done to avoid contention on the BRXD signal.

Depressing the reset push-button (S1) causes the following sequence of events:

1. Reset of the CPLD and MCU
2. Reset of FPGA through FPGA_GRSTn signal
3. FPGA configuration is cleared
4. If the dip-switch is set for SelectMAP configuration option, and there is a valid SmartMedia card inserted into the socket, then the FPGA will be configured. A SmartMedia card is valid if it complies with the SSFDC specification and contains a file named "main.txt" in the root directory. If the card is invalid or there is no card present, then the FPGA will not be configured.
5. The Main Menu will appear in the Terminal Window.

Note: The identical sequence of events occurs at power-up.

5.2 PPC Reset

The ET6000K10S also contains another RESET push-button (S3) used to reset the PPC. This signal is pulled up on the ET6000K10S. The user is responsible for debouncing the reset signal in the FPGA. Table 20 shows the connection between the reset push-button and the FPGA.

Table 20 - PPC Reset

Signal Name	FPGA Pin	Push-Button Switch
PPC_RESETn	U15.F24	S3.4

6 Memory

The ET6000K10S provides three different memory technologies to the user. FLASH, Synchronous SRAM, and DDR SDRAM in various densities.

6.1 FLASH

The FLASH (U14, U16) memory components on the ET6000K10S can accommodate up to 4M x 16 devices, refer to Figure 46. In addition to programming the FPGA and storing bitstreams, the FLASH may be used for non-volatile storage.

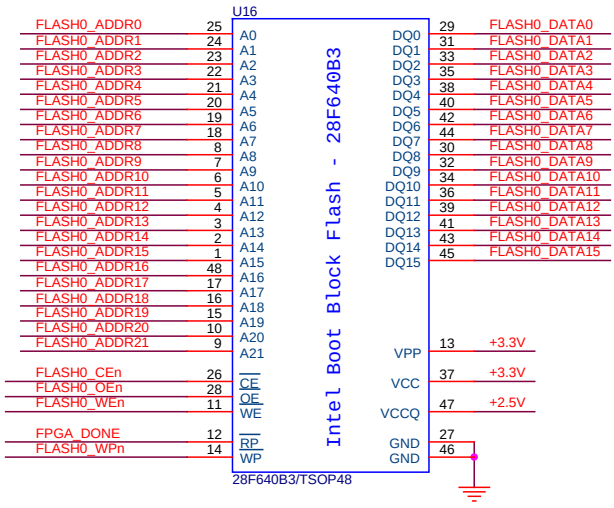


Figure 46 - FLASH Connection

The Intel Advanced Boot Block Flash Memory (C3) device, supports read-array mode operations at various IO voltages (1.8V and 3V) and erase and program operations at 3V or 12V VPP. On the ET6000K10SC, VPP is 3.3V. The ET6000K10SC interfaces to the FLASH at +2.5V levels.

This family of devices is capable of fast programming at 12V (not utilized on the ET6000K10SC). The C3 device features the following:

- Enhanced blocking for easy segmentation of code and data or additional design flexibility
- Program Suspend to Read command
- VCCQ input of 1.65V–2.5V or 2.7V–3.6V on all I/Os
- Maximum program and erase time specification for improved data storage

For more information on this part please refer to the Intel P/N TE28F640C3TC80 datasheet.

6.1.1 FLASH Connection to the FPGA

The FLASH memory components are connected to the FPGA on Bank 0 and Bank 1 as listed in Table 21. The VCCO of the IO banks are connected to +2.5V.

Table 21 - Connection between FPGA and FLASH

Signal Name	FPGA Pin	FLASH
FLASH0_ADDR0	U15.G26	U16.25

Signal Name	FPGA Pin	FLASH
FLASH0_ADDR1	U15.E27	U16.24
FLASH0_ADDR2	U15.K27	U16.23
FLASH0_ADDR3	U15.E30	U16.22
FLASH0_ADDR4	U15.F30	U16.21
FLASH0_ADDR5	U15.H26	U16.20
FLASH0_ADDR6	U15.L27	U16.19
FLASH0_ADDR7	U15.J26	U16.18
FLASH0_ADDR8	U15.F27	U16.8
FLASH0_ADDR9	U15.M27	U16.7
FLASH0_ADDR10	U15.G30	U16.6
FLASH0_ADDR11	U15.E28	U16.5
FLASH0_ADDR12	U15.L26	U16.4
FLASH0_ADDR13	U15.H27	U16.3
FLASH0_ADDR14	U15.F28	U16.2
FLASH0_ADDR15	U15.J30	U16.1
FLASH0_ADDR16	U15.K30	U16.48
FLASH0_ADDR17	U15.M26	U16.17
FLASH0_ADDR18	U15.J27	U16.16
FLASH0_ADDR19	U15.M29	U16.15
FLASH0_ADDR20	U15.D30	U16.10
FLASH0_ADDR21	U15.D27	U16.9
FLASH0_DATA0	U15.K31	U16.29
FLASH0_DATA1	U15.M30	U16.31
FLASH0_DATA2	U15.E33	U16.33
FLASH0_DATA3	U15.E31	U16.35
FLASH0_DATA4	U15.F31	U16.38
FLASH0_DATA5	U15.F33	U16.40
FLASH0_DATA6	U15.G33	U16.42
FLASH0_DATA7	U15.E34	U16.44

Signal Name	FPGA Pin	FLASH
FLASH0_DATA8	U15.L30	U16.30
FLASH0_DATA9	U15.D31	U16.32
FLASH0_DATA10	U15.L31	U16.34
FLASH0_DATA11	U15.E32	U16.36
FLASH0_DATA12	U15.F32	U16.39
FLASH0_DATA13	U15.D34	U16.41
FLASH0_DATA14	U15.H33	U16.43
FLASH0_DATA15	U15.H31	U16.45
FLASH0_CEn	U15.G27	U16.26
FLASH0_OEn	U15.K32	U16.28
FLASH0_WEn	U15.J33	U16.11
FLASH0_WPn	U15.M28	U16.14
FLASH1_ADDR0	U15.D9	U14.25
FLASH1_ADDR1	U15.D10	U14.24
FLASH1_ADDR2	U15.E11	U14.23
FLASH1_ADDR3	U15.H12	U14.22
FLASH1_ADDR4	U15.J12	U14.21
FLASH1_ADDR5	U15.E9	U14.20
FLASH1_ADDR6	U15.F11	U14.19
FLASH1_ADDR7	U15.F9	U14.18
FLASH1_ADDR8	U15.E10	U14.8
FLASH1_ADDR9	U15.H11	U14.7
FLASH1_ADDR10	U15.K12	U14.6
FLASH1_ADDR11	U15.J11	U14.5
FLASH1_ADDR12	U15.J17	U14.4
FLASH1_ADDR13	U15.G10	U14.3
FLASH1_ADDR14	U15.D12	U14.2
FLASH1_ADDR15	U15.D13	U14.1
FLASH1_ADDR16	U15.E13	U14.48

Signal Name	FPGA Pin	FLASH
FLASH1_ADDR17	U15.H10	U14.17
FLASH1_ADDR18	U15.K11	U14.16
FLASH1_ADDR19	U15.F12	U14.15
FLASH1_ADDR20	U15.G12	U14.10
FLASH1_ADDR21	U15.J10	U14.9
FLASH1_DATA0	U15.E15	U14.29
FLASH1_DATA1	U15.G13	U14.31
FLASH1_DATA2	U15.J16	U14.33
FLASH1_DATA3	U15.J13	U14.35
FLASH1_DATA4	U15.K13	U14.38
FLASH1_DATA5	U15.K16	U14.40
FLASH1_DATA6	U15.L16	U14.42
FLASH1_DATA7	U15.F17	U14.44
FLASH1_DATA8	U15.F13	U14.30
FLASH1_DATA9	U15.H13	U14.32
FLASH1_DATA10	U15.F15	U14.34
FLASH1_DATA11	U15.M15	U14.36
FLASH1_DATA12	U15.D16	U14.39
FLASH1_DATA13	U15.E17	U14.41
FLASH1_DATA14	U15.M16	U14.43
FLASH1_DATA15	U15.M13	U14.45
FLASH1_CEn	U15.F10	U14.26
FLASH1_OEn	U15.G16	U14.28
FLASH1_WEn	U15.D17	U14.11
FLASH1_WPn	U15.E12	U14.14

6.2 Synchronous SRAM

The Synchronous SRAM (U8, U9, U10, U11) memory components on the ET6000K10S can accommodate up to 2Mb x 36 devices (refer to Figure 47).

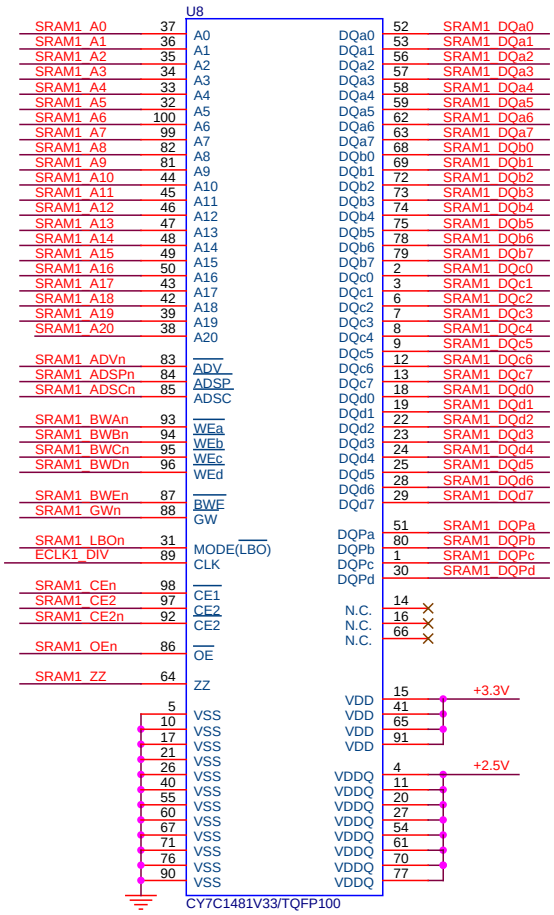


Figure 47 - SSRAM Connection

The SSRAM's can be stuffed with the following options:

- Pipelined
- Flow-through
- Pipelined with NoBL
- Flow-through with NoBL
- Pipelined ZBT
- Flow-trough ZBT

Syncburst Flow-through (Figure 48) is the most straightforward type of SSRAM. Write data may be accepted on the same clock cycle as the activation signal and address, and read data is returned one clock cycle after it is requested. Syncburst is designed to allow

two controllers to access the same SSRAM, using two activation signals, ADSC# and ADSP#; an activation with ADSP# requires data and byte enables one clock cycle after the address and activation.

Syncburst Pipelined (Figure 49) is identical except for registered outputs, which delay read data an additional clock cycle but may be necessary for high speed designs.

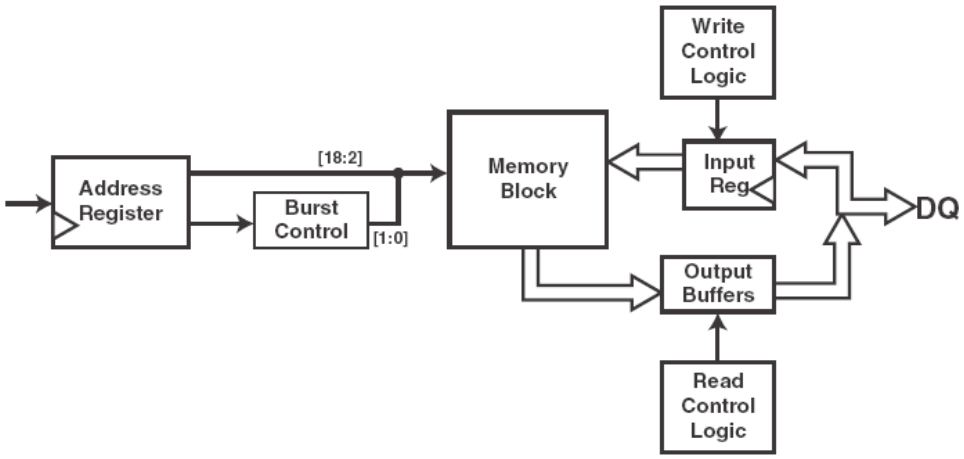


Figure 48 - SSRAM Flow-trough

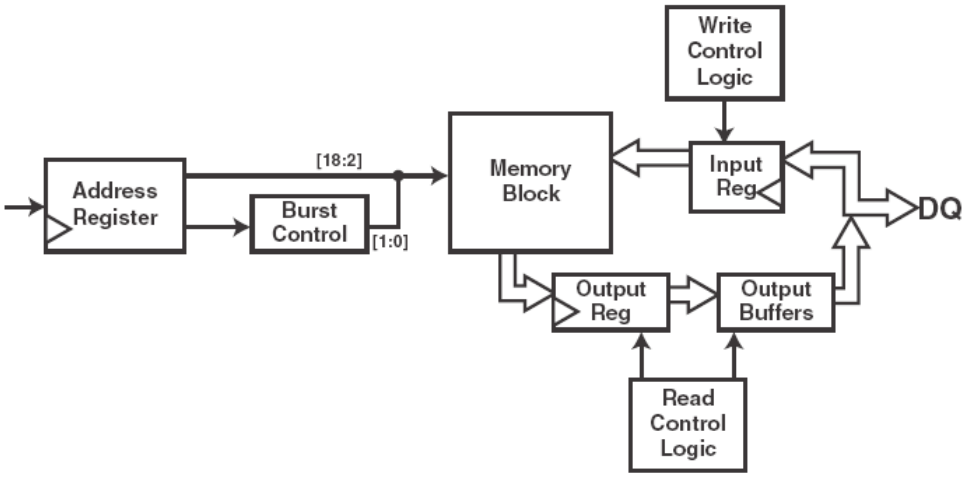


Figure 49 - SSRAM Pipeline

Zero-Bus-Turnaround (ZBT) SSRAM's are designed to eliminate wait states between reads and writes by synchronizing data. Figure 50 accept and return data one clock cycle after the address phase, and ZBT Pipeline SSRAMs (Figure 51) accept and return data two clock cycles after the address phase. This allows the user to begin a write burst

immediately after the last word of a read burst, because read data will be returned before the first write data is required. The timing is illustrated in Figure 52.

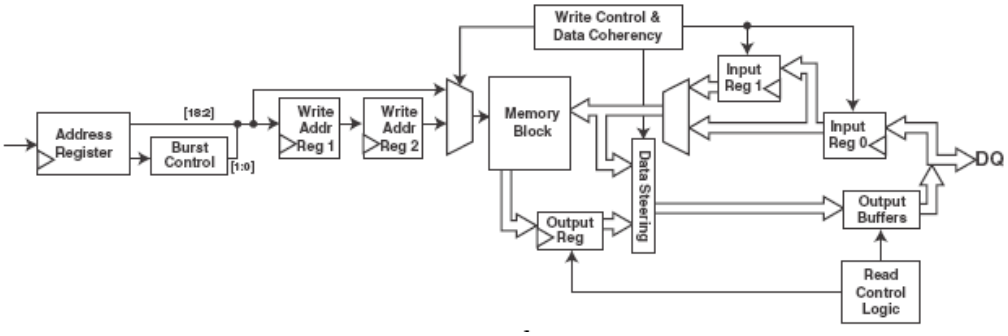


Figure 50 - SSRAM ZBT Flow-trough

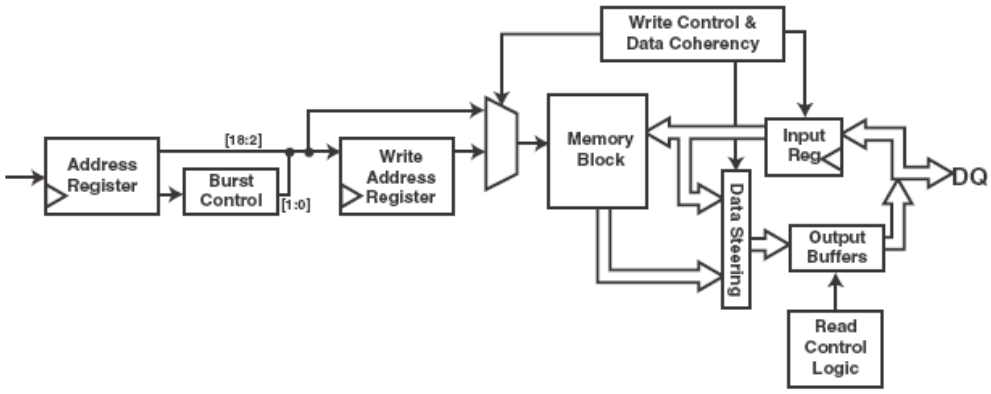


Figure 51 - SSRAM ZBT Pipeline

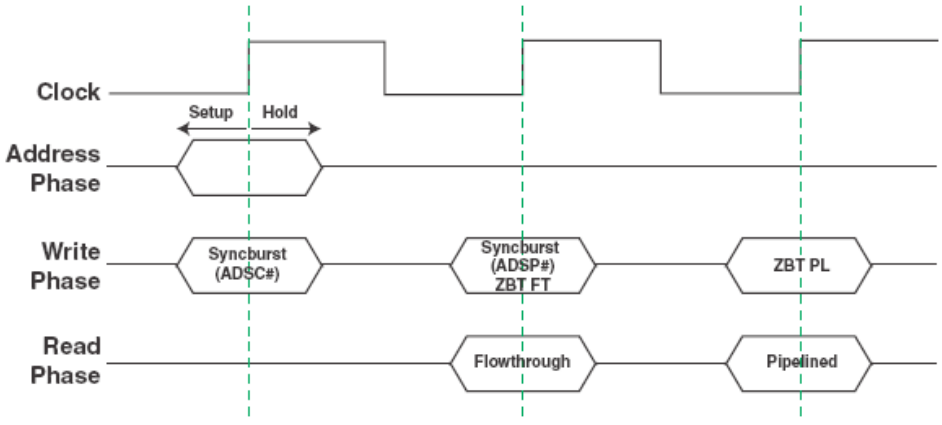


Figure 52 - Syncburst and ZBT SSRAM Timing

6.2.1 SSRAM Configuration

The ET6000K10S is factory stuffed with the Cypress P/N CY7C1380B-133AC SSRAM devices (please refer to datasheet for more information). There are 524,288 x 36 SSRAM cells with advanced synchronous peripheral circuitry and a 2-bit counter for internal burst operation. All synchronous inputs are gated by registers controlled by a positive-edge-triggered Clock Input (ECLK[1..4]). The synchronous inputs include all addresses, all data inputs, address-pipelining Chip Enable (CE), burst control inputs (ADSC, ADSP, and ADV), write enables (BWa, BWb, BWc, BWd and BWE), and Global Write (GW).

Asynchronous inputs include the Output Enable (OE) and burst mode control (MODE), DQa,b,c,d and DPa,b,c,d. a, b, c, d each are 8 bits wide in the case of DQ and 1 bit wide in the case of DP. Addresses and chip enables are registered with either Address Status Processor (ADSP) or Address Status Controller (ADSC) input pins. Subsequent burst addresses can be internally generated as controlled by the Burst Advance Pin (ADV).

Address, data inputs, and write controls are registered on-chip to initiate self-timed WRITE cycle. WRITE cycles can be one to four bytes wide as controlled by the write control inputs. Individual byte write allows individual byte to be written. Bwa controls DQa and DPa. BWb controls DQb and DPb. BWc controls DQc and DPc. BWd controls DQd and DPd. BWa, BWb, BWc, and BWd can be active only with BWE being LOW. GW being LOW causes all bytes to be written. WRITE pass-through capability allows written data available at the output for the immediately next READ cycle. This device also incorporates pipelined enable circuit for easy depth expansion without penalizing system performance. All inputs and outputs of the CY7C1380B and is JEDEC standard JESD8-5 compatible.

Note: CE2 and CE2n are hard-wired on PWB to there respective active states. Use SRAM_CExn signal to select the individual devices.

6.2.2 SSRAM Clocking

The SSRAMs are clocked directly by RoboClock #2 (U26). ECLK1, ECLK2, ECLK3, and ECLK4 are LVTTL33 signals and the SSRAMs are LVCMOS25. The CLK interface is level translated by the flowing circuit in Figure 53:

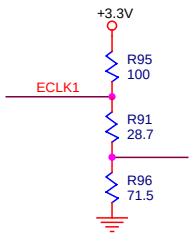


Figure 53 - Clock Level Translation

6.2.3 SRAM Termination

No termination is necessary, but the option to use DCI is available on all signals.

6.2.4 SSRAM Connection to the FPGA

The SSRAM memory components are connected to the FPGA on Bank 2 and Bank 3 as listed in Table 22. The VCCO of the IO banks are connected to +2.5V.

Table 22 - Connection between FPGA and SRAM's

Signal Name	FPGA Pin	SSRAM
SRAM1_A0	U15.L1	U8.37
SRAM1_A1	U15.K1	U8.36
SRAM1_A2	U15.J1	U8.35
SRAM1_A3	U15.G1	U8.34
SRAM1_A4	U15.F1	U8.33
SRAM1_A5	U15.E1	U8.32
SRAM1_A6	U15.F3	U8.100
SRAM1_A7	U15.G3	U8.99
SRAM1_A8	U15.H3	U8.82
SRAM1_A9	U15.K3	U8.81
SRAM1_A10	U15.H2	U8.44
SRAM1_A11	U15.J2	U8.45
SRAM1_A12	U15.K2	U8.46
SRAM1_A13	U15.L2	U8.47
SRAM1_A14	U15.M2	U8.48
SRAM1_A15	U15.D3	U8.49
SRAM1_A16	U15.E3	U8.50
SRAM1_A17	U15.G2	U8.43
SRAM1_A18	U15.F2	U8.42
SRAM1_A19	U15.E2	U8.39
SRAM1_A20	U15.D2	U8.38
SRAM1_ADSCn	U15.F4	U8.85
SRAM1_ADSPn	U15.M3	U8.84

Signal Name	FPGA Pin	SSRAM
SRAM1_ADVn	U15.L3	U8.83
SRAM1_BWAn	U15.G4	U8.93
SRAM1_BWBn	U15.H4	U8.94
SRAM1_BWCn	U15.J4	U8.95
SRAM1_BWDn	U15.L4	U8.96
SRAM1_BWEn	U15.M4	U8.87
SRAM1_CEn	U15.H5	U8.98
SRAM1_DQA0	U15.D6	U8.52
SRAM1_DQA1	U15.E6	U8.53
SRAM1_DQA2	U15.G6	U8.56
SRAM1_DQA3	U15.H6	U8.57
SRAM1_DQA4	U15.J6	U8.58
SRAM1_DQA5	U15.K6	U8.59
SRAM1_DQA6	U15.L6	U8.62
SRAM1_DQA7	U15.N6	U8.63
SRAM1_DQB0	U15.D7	U8.68
SRAM1_DQB1	U15.E7	U8.69
SRAM1_DQB2	U15.F7	U8.72
SRAM1_DQB3	U15.H7	U8.73
SRAM1_DQB4	U15.J7	U8.74
SRAM1_DQB5	U15.K7	U8.75
SRAM1_DQB6	U15.L7	U8.78
SRAM1_DQB7	U15.M7	U8.79
SRAM1_DQC0	U15.N7	U8.2
SRAM1_DQC1	U15.J8	U8.3
SRAM1_DQC2	U15.K8	U8.6
SRAM1_DQC3	U15.L8	U8.7
SRAM1_DQC4	U15.M8	U8.8
SRAM1_DQC5	U15.N8	U8.9

Signal Name	FPGA Pin	SSRAM
SRAM1_DQC6	U15.K9	U8.12
SRAM1_DQC7	U15.L9	U8.13
SRAM1_DQD0	U15.M9	U8.18
SRAM1_DQD1	U15.N9	U8.19
SRAM1_DQD2	U15.L10	U8.22
SRAM1_DQD3	U15.M10	U8.23
SRAM1_DQD4	U15.N10	U8.24
SRAM1_DQD5	U15.P10	U8.25
SRAM1_DQD6	U15.M11	U8.28
SRAM1_DQD7	U15.N11	U8.29
SRAM1_DQPA	U15.P11	U8.51
SRAM1_DQPB	U15.R11	U8.80
SRAM1_DQPC	U15.T11	U8.1
SRAM1_DQPD	U15.M12	U8.30
SRAM1_GWn	U15.G5	U8.88
SRAM1_LBON	U15.D1	U8.31
SRAM1_OEn	U15.L5	U8.86
SRAM1_ZZ	U15.M5	U8.64
SRAM2_A0	U15.N2	U9.37
SRAM2_A1	U15.W1	U9.36
SRAM2_A2	U15.V1	U9.35
SRAM2_A3	U15.U1	U9.34
SRAM2_A4	U15.R1	U9.33
SRAM2_A5	U15.P1	U9.32
SRAM2_A6	U15.W3	U9.100
SRAM2_A7	U15.Y3	U9.99
SRAM2_A8	U15.AA3	U9.82
SRAM2_A9	U15.N4	U9.81
SRAM2_A10	U15.V2	U9.44

Signal Name	FPGA Pin	SSRAM
SRAM2_A11	U15.W2	U9.45
SRAM2_A12	U15.N3	U9.46
SRAM2_A13	U15.P3	U9.47
SRAM2_A14	U15.R3	U9.48
SRAM2_A15	U15.T3	U9.49
SRAM2_A16	U15.U3	U9.50
SRAM2_A17	U15.U2	U9.43
SRAM2_A18	U15.T2	U9.42
SRAM2_A19	U15.R2	U9.39
SRAM2_A20	U15.P2	U9.38
SRAM2_ADSCn	U15.V4	U9.85
SRAM2_ADSPn	U15.U4	U9.84
SRAM2_ADVn	U15.T4	U9.83
SRAM2_BWAn	U15.W4	U9.93
SRAM2_BWBn	U15.Y4	U9.94
SRAM2_BWCn	U15.AA4	U9.95
SRAM2_BWDn	U15.N5	U9.96
SRAM2_BWEn	U15.P5	U9.87
SRAM2_CEn	U15.T5	U9.98
SRAM2_DQA0	U15.R6	U9.52
SRAM2_DQA1	U15.T6	U9.53
SRAM2_DQA2	U15.U6	U9.56
SRAM2_DQA3	U15.W6	U9.57
SRAM2_DQA4	U15.Y6	U9.58
SRAM2_DQA5	U15.AA6	U9.59
SRAM2_DQA6	U15.P7	U9.62
SRAM2_DQA7	U15.T7	U9.63
SRAM2_DQB0	U15.U7	U9.68
SRAM2_DQB1	U15.V7	U9.69

Signal Name	FPGA Pin	SSRAM
SRAM2_DQB2	U15.W7	U9.72
SRAM2_DQB3	U15.Y7	U9.73
SRAM2_DQB4	U15.AA7	U9.74
SRAM2_DQB5	U15.P8	U9.75
SRAM2_DQB6	U15.R8	U9.78
SRAM2_DQB7	U15.T8	U9.79
SRAM2_DQC0	U15.U8	U9.2
SRAM2_DQC1	U15.V8	U9.3
SRAM2_DQC2	U15.W8	U9.6
SRAM2_DQC3	U15.P9	U9.7
SRAM2_DQC4	U15.R9	U9.8
SRAM2_DQC5	U15.U9	U9.9
SRAM2_DQC6	U15.W9	U9.12
SRAM2_DQC7	U15.Y9	U9.13
SRAM2_DQD0	U15.AA9	U9.18
SRAM2_DQD1	U15.R10	U9.19
SRAM2_DQD2	U15.T10	U9.22
SRAM2_DQD3	U15.U10	U9.23
SRAM2_DQD4	U15.V10	U9.24
SRAM2_DQD5	U15.W10	U9.25
SRAM2_DQD6	U15.V5	U9.28
SRAM2_DQD7	U15.AA10	U9.29
SRAM2_DQPA	U15.U11	U9.51
SRAM2_DQPB	U15.V11	U9.80
SRAM2_DQPC	U15.W11	U9.1
SRAM2_DQPD	U15.Y11	U9.30
SRAM2_GWn	U15.R5	U9.88
SRAM2_LBOn	U15.N1	U9.31
SRAM2_OEn	U15.W5	U9.86

Signal Name	FPGA Pin	SSRAM
SRAM2_ZZ	U15.P6	U9.64
SRAM3_A0	U15.AD2	U10.37
SRAM3_A1	U15.AK1	U10.36
SRAM3_A2	U15.AJ1	U10.35
SRAM3_A3	U15.AH1	U10.34
SRAM3_A4	U15.AF1	U10.33
SRAM3_A5	U15.AE1	U10.32
SRAM3_A6	U15.AJ3	U10.100
SRAM3_A7	U15.AB4	U10.99
SRAM3_A8	U15.AC4	U10.82
SRAM3_A9	U15.AD4	U10.81
SRAM3_A10	U15.AJ2	U10.44
SRAM3_A11	U15.AB3	U10.45
SRAM3_A12	U15.AC3	U10.46
SRAM3_A13	U15.AD3	U10.47
SRAM3_A14	U15.AF3	U10.48
SRAM3_A15	U15.AG3	U10.49
SRAM3_A16	U15.AH3	U10.50
SRAM3_A17	U15.AH2	U10.43
SRAM3_A18	U15.AG2	U10.42
SRAM3_A19	U15.AF2	U10.39
SRAM3_A20	U15.AE2	U10.38
SRAM3_ADSCn	U15.AG4	U10.85
SRAM3_ADSPn	U15.AF4	U10.84
SRAM3_ADVn	U15.AE4	U10.83
SRAM3_BWAn	U15.AE5	U10.93
SRAM3_BWBn	U15.AH12	U10.94
SRAM3_BWCn	U15.AF5	U10.95
SRAM3_BWDn	U15.AG5	U10.96

Signal Name	FPGA Pin	SSRAM
SRAM3_BWEn	U15.AH5	U10.87
SRAM3_CEN	U15.AB6	U10.98
SRAM3_DQA0	U15.AH6	U10.52
SRAM3_DQA1	U15.AJ6	U10.53
SRAM3_DQA2	U15.AB7	U10.56
SRAM3_DQA3	U15.AC7	U10.57
SRAM3_DQA4	U15.AD7	U10.58
SRAM3_DQA5	U15.AE7	U10.59
SRAM3_DQA6	U15.AF7	U10.62
SRAM3_DQA7	U15.AG7	U10.63
SRAM3_DQB0	U15.AJ7	U10.68
SRAM3_DQB1	U15.AD8	U10.69
SRAM3_DQB2	U15.AE8	U10.72
SRAM3_DQB3	U15.AF8	U10.73
SRAM3_DQB4	U15.AG8	U10.74
SRAM3_DQB5	U15.AH8	U10.75
SRAM3_DQB6	U15.AJ8	U10.78
SRAM3_DQB7	U15.AB9	U10.79
SRAM3_DQC0	U15.AC9	U10.2
SRAM3_DQC1	U15.AD9	U10.3
SRAM3_DQC2	U15.AF9	U10.6
SRAM3_DQC3	U15.AH9	U10.7
SRAM3_DQC4	U15.AJ9	U10.8
SRAM3_DQC5	U15.AB10	U10.9
SRAM3_DQC6	U15.AC10	U10.12
SRAM3_DQC7	U15.AD10	U10.13
SRAM3_DQD0	U15.AE10	U10.18
SRAM3_DQD1	U15.AF10	U10.19
SRAM3_DQD2	U15.AG10	U10.22

Signal Name	FPGA Pin	SSRAM
SRAM3_DQD3	U15.AH10	U10.23
SRAM3_DQD4	U15.AJ10	U10.24
SRAM3_DQD5	U15.AC11	U10.25
SRAM3_DQD6	U15.AD11	U10.28
SRAM3_DQD7	U15.AE11	U10.29
SRAM3_DQPA	U15.AF11	U10.51
SRAM3_DQPB	U15.AG11	U10.80
SRAM3_DQPC	U15.AH11	U10.1
SRAM3_DQPD	U15.AJ11	U10.30
SRAM3_GWn	U15.AJ5	U10.88
SRAM3_LBOn	U15.AD1	U10.31
SRAM3_OEn	U15.AF6	U10.86
SRAM3_ZZ	U15.AG6	U10.64
SRAM4_A0	U15.AW1	U11.37
SRAM4_A1	U15.AV1	U11.36
SRAM4_A2	U15.AU1	U11.35
SRAM4_A3	U15.AT1	U11.34
SRAM4_A4	U15.AP1	U11.33
SRAM4_A5	U15.AN1	U11.32
SRAM4_A6	U15.AL3	U11.100
SRAM4_A7	U15.AM3	U11.99
SRAM4_A8	U15.AN3	U11.82
SRAM4_A9	U15.AR3	U11.81
SRAM4_A10	U15.AP2	U11.44
SRAM4_A11	U15.AR2	U11.45
SRAM4_A12	U15.AT2	U11.46
SRAM4_A13	U15.AU2	U11.47
SRAM4_A14	U15.AV2	U11.48
SRAM4_A15	U15.AW2	U11.49

Signal Name	FPGA Pin	SSRAM
SRAM4_A16	U15.AK3	U11.50
SRAM4_A17	U15.AN2	U11.43
SRAM4_A18	U15.AM2	U11.42
SRAM4_A19	U15.AL2	U11.39
SRAM4_A20	U15.AK2	U11.38
SRAM4_ADSCn	U15.AV3	U11.85
SRAM4_ADSPn	U15.AU3	U11.84
SRAM4_ADVn	U15.AT3	U11.83
SRAM4_BWAn	U15.AW3	U11.93
SRAM4_BWBn	U15.AK4	U11.94
SRAM4_BWCn	U15.AL4	U11.95
SRAM4_BWDn	U15.AM4	U11.96
SRAM4_BWEn	U15.AP4	U11.87
SRAM4_CEn	U15.AT4	U11.98
SRAM4_DQA0	U15.AN5	U11.52
SRAM4_DQA1	U15.AP5	U11.53
SRAM4_DQA2	U15.AR5	U11.56
SRAM4_DQA3	U15.AT5	U11.57
SRAM4_DQA4	U15.AY5	U11.58
SRAM4_DQA5	U15.AK6	U11.59
SRAM4_DQA6	U15.AM6	U11.62
SRAM4_DQA7	U15.AN6	U11.63
SRAM4_DQB0	U15.AP6	U11.68
SRAM4_DQB1	U15.AR6	U11.69
SRAM4_DQB2	U15.AT6	U11.72
SRAM4_DQB3	U15.AY6	U11.73
SRAM4_DQB4	U15.AK7	U11.74
SRAM4_DQB5	U15.AL7	U11.75
SRAM4_DQB6	U15.AM7	U11.78

Signal Name	FPGA Pin	SSRAM
SRAM4_DQB7	U15.AN7	U11.79
SRAM4_DQC0	U15.AP7	U11.2
SRAM4_DQC1	U15.AR7	U11.3
SRAM4_DQC2	U15.AU7	U11.6
SRAM4_DQC3	U15.AV7	U11.7
SRAM4_DQC4	U15.AW7	U11.8
SRAM4_DQC5	U15.AK8	U11.9
SRAM4_DQC6	U15.AL8	U11.12
SRAM4_DQC7	U15.AM8	U11.13
SRAM4_DQD0	U15.AN8	U11.18
SRAM4_DQD1	U15.AP8	U11.19
SRAM4_DQD2	U15.AT8	U11.22
SRAM4_DQD3	U15.AU8	U11.23
SRAM4_DQD4	U15.AK9	U11.24
SRAM4_DQD5	U15.AL9	U11.25
SRAM4_DQD6	U15.AM9	U11.28
SRAM4_DQD7	U15.AN9	U11.29
SRAM4_DQPA	U15.AK10	U11.51
SRAM4_DQPB	U15.AL10	U11.80
SRAM4_DQPC	U15.AM10	U11.1
SRAM4_DQPD	U15.AL11	U11.30
SRAM4_GWn	U15.AR4	U11.88
SRAM4_LBOn	U15.AM1	U11.31
SRAM4_OEn	U15.AL5	U11.86
SRAM4_ZZ	U15.AM5	U11.64
SRAM_CSn	U7.20	U5.116

6.3 DDR SDRAM

Double Data Rate (DDR) SDRAM represents an enhancement to the traditional SDRAM. Instead of data and control signals operating at the same frequency, data

operates at twice the clock frequency, while address and control operate at the base clock frequency. In other words, the data is written or read from the part on every clock transition, or twice per clock cycle. This effectively doubles the throughput of the memory device.

The trade-off for such an improvement in throughput is increased complexity in interface logic to the DDR memory, as well as increased complexity in routing the DDR signals on the printed circuit board. Additionally, this memory has the same latencies as standard SDRAM, so that while the data transfers are twice as fast, the latencies associated with DDR SDRAM are on par with standard SDRAM.

6.3.1 Basics of DDR Operation

DDR SDRAM provides data capture at a rate of twice the clock frequency. Therefore, DDR SDRAM with a clock frequency of 100 MHz has a peak data transfer rate of 200 MHz or 6.4 Gigabits per second for a 16-bit interface. In order to maintain high-speed signal integrity and stringent timing goals, a bi-directional data strobe is used in conjunction with SSTL_2 signaling standard as well as differential clocks. DDR SDRAM operates as a source-synchronous system, in which data is captured twice per clock cycle, using a bi-directional data strobe to clock the data. The DDR SDRAM control bus consists of a clock enable, chip select, row and column addresses, bank address, and a write enable. Commands are entered on the positive edges of the clock, and data occurs for both positive and negative edges of the clock. The double data rate memory utilizes a differential pair for the system clock and, therefore, has both a true clock (CK) and complementary clock (CK#) signal.

6.3.2 DDR SDRAM Configuration

The DDR SDRAM memory components on the ET6000K10S are arranged as a 16-bit mode (refer to Figure 54). Made up of four discrete parts (U20, U21, U22, U23), the components used are 64-Mb x 16 parts, organized as 16 million deep by 16-bits wide and 4 banks. This provides for a total capacity of 128-Mbytes for the system (for more information, refer to Micron's datasheet PN MT46V64M16).

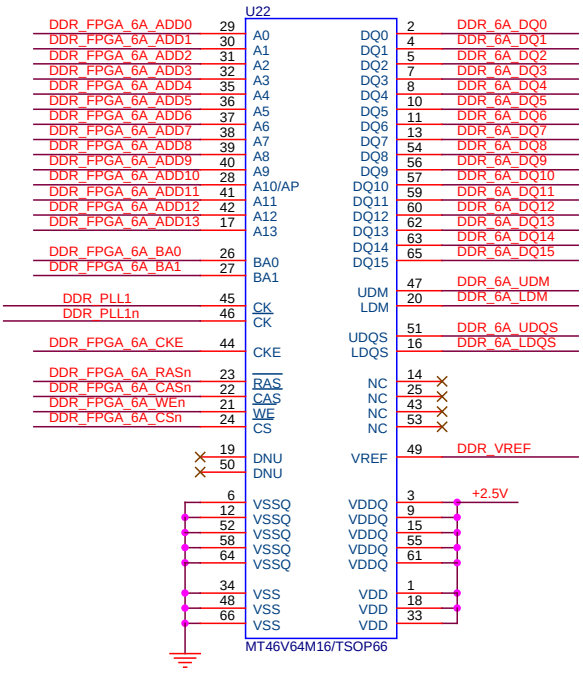


Figure 54 - DDR SDRAM Connection

6.3.3 DDR SDRAM Clocking

Refer to the DDR Clocking Section.

6.3.4 DDR SDRAM Termination

DDR SDRAM is based on the SSTL2 (JEDEC Standard - Stub Series Terminated Logic for 2.5V) signaling standard. The SSTL2 termination model used for DDR SDRAM has two types of termination:

- Class 1
  - Also called SSTL2_I
  - Used for unidirectional signaling (Control signals)
- Class 2
  - Also called SSTL2_II
  - Used for bi-directional signaling (Data signals)

Both Class 1 and Class 2 are based on a 50Ω controlled impedance environment, and termination to VTT, a 1.25V power supply.

SSTL2 Class 1 termination is used for unidirectional signaling, such as control signals. It is based on a 50Ω controlled impedance driver, a 50Ω controlled impedance transmission line, and a 50Ω parallel termination to VTT at the receiver. Figure 55 shows a basic SSTL2 Class 1 circuit. The driver is brought to 50Ω by the addition of a 25Ω series resistor immediately adjacent to the driver (implemented using DCI, thus no need for an external component).

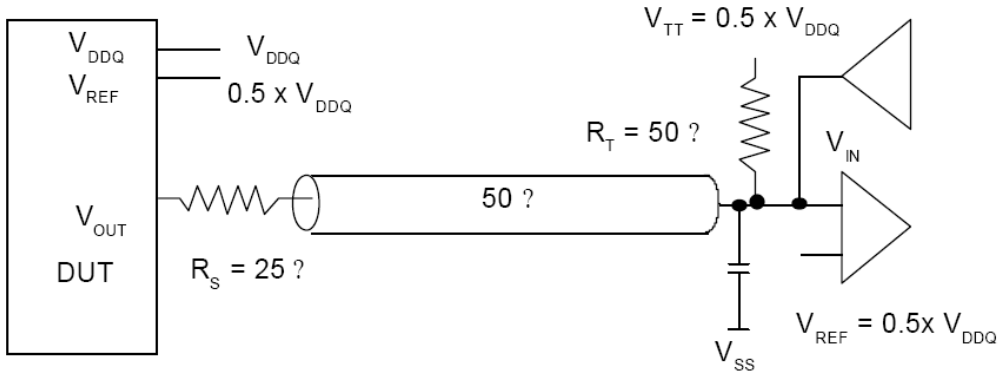


Figure 55 - SSTL2 Class 1 Termination

SSTL2 Class 2 termination is used for bi-directional signaling, such as data signals. It is based on a 50Ω controlled impedance driver and a 50Ω parallel termination to VTT for the receiver at both ends, connected through a 50Ω controlled impedance transmission line. Figure 56 shows a basic SSTL2 Class 2 circuit. The driver is brought to 50Ω by the addition of a 25Ω series resistor immediately adjacent to the driver.

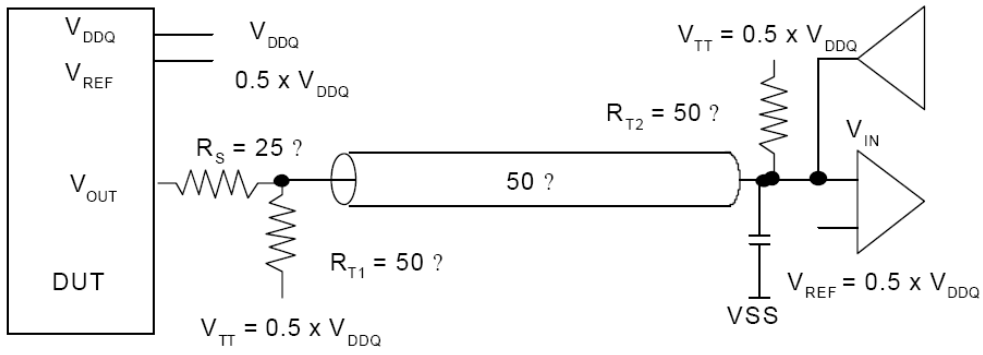


Figure 56 - SSTL2 Class 2 Termination

Note: DCI termination must be implemented in the DDR SDRAM controller design.

6.3.5 DDR SDRAM Power Supply

The DATEL +2.5V module (U30) is used to supply power to the +2.5V plane that supplies the VDDQ pins of the DDR SDRAM devices. According to the JEDEC Specification – Double Data Rate (DDR) SDRAM termination voltage VTT must track 50% of VDDQ over voltage, temperature and noise. The ML6554 (U24) is used as a voltage source for DDR termination. Connecting the V_{REF} pin to the +2.5V supply allows the regulator to track the VDDQ supply (refer to Figure 57). A dedicated VREF output supplies the VREF pins on the FPGA as well as on the DDR SDRAM devices and maintains a less that 40mV offset from VTT.

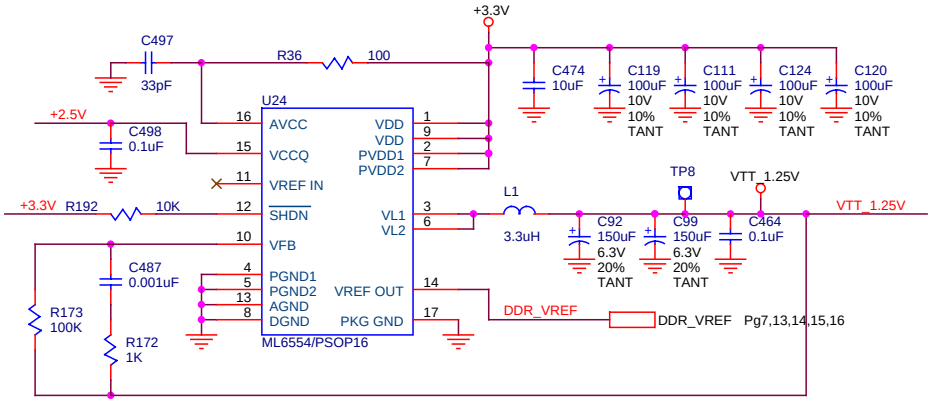


Figure 57 - DDR VTT Termination Regulator

6.3.6 DDR SDRAM Connection to the FPGA

The DDR SDRAM memory components are connected to the FPGA on Bank 6 and Bank 7. As mentioned, the connections between the FPGA and the DDR SDRAM are not homogeneous, as control and address are handled differently from the data and differently from the clocks. However, all of these signals are controlled impedance, and are SSTL2 terminated. The termination of these signals is covered in DDR SDRAM Termination.

The Data signals (DQ), the Data Strobe (DQS) and the Data Mask (DM) signals are point-to-point signals, going from the FPGA to the DDR SDRAM components. As mentioned above, these signals are controlled impedance, and terminated according to the DDR SDRAM specification. This termination is covered below in DDR SDRAM Termination. The connection of the Data, the Data Strobe and the Data Mask signals between the FPGA and the DDR SDRAM components in covered in Table 23.

The data, data strobe, and data mask signals all serve different purposes. The data signals are self-evident, carrying the raw data between the chips, and are bi-directional. The data strobe signals are responsible for actual clocking in the data on rising and falling edges of the clock. Finally, the data mask signals can be used to enable or disable the reading and writing of some of the bytes in a 16-bit word transaction.

Table 23 - Connection between FPGA and DDR SDRAM

Signal Name	FPGA Pin	DDR SDRAM
DDR_6A_ADD0	U15.AF42	U22.29
DDR_6A_ADD1	U15.AF39	U22.30
DDR_6A_ADD2	U15.AF36	U22.31
DDR_6A_ADD3	U15.AF34	U22.32
DDR_6A_ADD4	U15.AF33	U22.35
DDR_6A_ADD5	U15.AF35	U22.36
DDR_6A_ADD6	U15.AF37	U22.37
DDR_6A_ADD7	U15.AF40	U22.38
DDR_6A_ADD8	U15.AE35	U22.39
DDR_6A_ADD9	U15.AE41	U22.40
DDR_6A_ADD10	U15.AE36	U22.28
DDR_6A_ADD11	U15.AG41	U22.41
DDR_6A_ADD12	U15.AD42	U22.42
DDR_6A_ADD13	U15.AE38	U22.17
DDR_6A_DATA0	U15.AE31	U22.2
DDR_6A_DATA1	U15.AF32	U22.4
DDR_6A_DATA2	U15.AE32	U22.5
DDR_6A_DATA3	U15.AE33	U22.7
DDR_6A_DATA4	U15.AD37	U22.8
DDR_6A_DATA5	U15.AD38	U22.10
DDR_6A_DATA6	U15.AD31	U22.11
DDR_6A_DATA7	U15.AD32	U22.13
DDR_6A_DATA8	U15.AD33	U22.54
DDR_6A_DATA9	U15.AD34	U22.56
DDR_6A_DATA10	U15.AC36	U22.57
DDR_6A_DATA11	U15.AC37	U22.59
DDR_6A_DATA12	U15.AC31	U22.60
DDR_6A_DATA13	U15.AC32	U22.62

Signal Name	FPGA Pin	DDR SDRAM
DDR_6A_DATA14	U15.AB33	U22.63
DDR_6A_DATA15	U15.AB34	U22.65
DDR_FPGA_6A_UDQS	U15.AC34	U22.51
DDR_FPGA_6A_LDQS	U15.AD36	U22.16
DDR_FPGA_6A_UDM	U15.AD39	U22.47
DDR_FPGA_6A_LDM	U15.AG31	U22.20
DDR_FPGA_6A_BA0	U15.AD41	U22.26
DDR_FPGA_6A_BA1	U15.AE42	U22.27
DDR_FPGA_6A_CASn	U15.AB40	U22.22
DDR_FPGA_6A_CKE	U15.AB36	U22.44
DDR_FPGA_6A_CSn	U15.AC39	U22.24
DDR_FPGA_6A_RASn	U15.AB37	U22.23
DDR_FPGA_6A_WEn	U15.AB39	U22.21
DDR_6B_ADD0	U15.AT40	U23.29
DDR_6B_ADD1	U15.AV42	U23.30
DDR_6B_ADD2	U15.AV40	U23.31
DDR_6B_ADD3	U15.AW41	U23.32
DDR_6B_ADD4	U15.AW40	U23.35
DDR_6B_ADD5	U15.AW42	U23.36
DDR_6B_ADD6	U15.AV41	U23.37
DDR_6B_ADD7	U15.AU39	U23.38
DDR_6B_ADD8	U15.AU41	U23.39
DDR_6B_ADD9	U15.AU42	U23.40
DDR_6B_ADD10	U15.AT39	U23.28
DDR_6B_ADD11	U15.AT42	U23.41
DDR_6B_ADD12	U15.AN42	U23.42
DDR_6B_ADD13	U15.AM37	U23.17
DDR_6B_DATA0	U15.AR37	U23.2
DDR_6B_DATA1	U15.AT38	U23.4

Signal Name	FPGA Pin	DDR SDRAM
DDR_6B_DATA2	U15.AP36	U23.5
DDR_6B_DATA3	U15.AP37	U23.7
DDR_6B_DATA4	U15.AP35	U23.8
DDR_6B_DATA5	U15.AR36	U23.10
DDR_6B_DATA6	U15.AN35	U23.11
DDR_6B_DATA7	U15.AN36	U23.13
DDR_6B_DATA8	U15.AM34	U23.54
DDR_6B_DATA9	U15.AM35	U23.56
DDR_6B_DATA10	U15.AL33	U23.57
DDR_6B_DATA11	U15.AL34	U23.59
DDR_6B_DATA12	U15.AL38	U23.60
DDR_6B_DATA13	U15.AL39	U23.62
DDR_6B_DATA14	U15.AL31	U23.63
DDR_6B_DATA15	U15.AL32	U23.65
DDR_FPGA_6B_UDQS	U15.AL36	U23.51
DDR_FPGA_6B_LDQS	U15.AP39	U23.16
DDR_FPGA_6B_UDM	U15.AL40	U23.47
DDR_FPGA_6B_LDM	U15.AN37	U23.20
DDR_FPGA_6B_BA0	U15.AN41	U23.26
DDR_FPGA_6B_BA1	U15.AT41	U23.27
DDR_FPGA_6B_CASn	U15.AM41	U23.22
DDR_FPGA_6B_CKE	U15.AM39	U23.44
DDR_FPGA_6B_CSn	U15.AM38	U23.24
DDR_FPGA_6B_RASn	U15.AN40	U23.23
DDR_FPGA_6B_WEn	U15.AM42	U23.21
DDR_7A_ADD0	U15.G41	U20.29
DDR_7A_ADD1	U15.H38	U20.30
DDR_7A_ADD2	U15.H40	U20.31
DDR_7A_ADD3	U15.J41	U20.32

Signal Name	FPGA Pin	DDR SDRAM
DDR_7A_ADD4	U15.J42	U20.35
DDR_7A_ADD5	U15.H41	U20.36
DDR_7A_ADD6	U15.H39	U20.37
DDR_7A_ADD7	U15.G42	U20.38
DDR_7A_ADD8	U15.G39	U20.39
DDR_7A_ADD9	U15.F42	U20.40
DDR_7A_ADD10	U15.G38	U20.28
DDR_7A_ADD11	U15.F40	U20.41
DDR_7A_ADD12	U15.E42	U20.42
DDR_7A_ADD13	U15.F36	U20.17
DDR_7A_DATA0	U15.N35	U20.2
DDR_7A_DATA1	U15.N36	U20.4
DDR_7A_DATA2	U15.M38	U20.5
DDR_7A_DATA3	U15.M39	U20.7
DDR_7A_DATA4	U15.M33	U20.8
DDR_7A_DATA5	U15.M34	U20.10
DDR_7A_DATA6	U15.M31	U20.11
DDR_7A_DATA7	U15.M32	U20.13
DDR_7A_DATA8	U15.L34	U20.54
DDR_7A_DATA9	U15.L35	U20.56
DDR_7A_DATA10	U15.K36	U20.57
DDR_7A_DATA11	U15.K35	U20.59
DDR_7A_DATA12	U15.K38	U20.60
DDR_7A_DATA13	U15.K37	U20.62
DDR_7A_DATA14	U15.J39	U20.63
DDR_7A_DATA15	U15.J38	U20.65
DDR_FPGA_7A_UDQS	U15.K34	U20.51
DDR_FPGA_7A_LDQS	U15.M41	U20.16
DDR_FPGA_7A_UDM	U15.H36	U20.47

Signal Name	FPGA Pin	DDR SDRAM
DDR_FPGA_7A_LDM	U15.L42	U20.20
DDR_FPGA_7A_BA0	U15.F39	U20.26
DDR_FPGA_7A_BA1	U15.F41	U20.27
DDR_FPGA_7A_CASn	U15.D41	U20.22
DDR_FPGA_7A_CKE	U15.E40	U20.44
DDR_FPGA_7A_CSn	U15.E41	U20.24
DDR_FPGA_7A_RASn	U15.D42	U20.23
DDR_FPGA_7A_WEn	U15.D40	U20.21
DDR_7B_ADD0	U15.V39	U21.29
DDR_7B_ADD1	U15.V41	U21.30
DDR_7B_ADD2	U15.W37	U21.31
DDR_7B_ADD3	U15.W41	U21.32
DDR_7B_ADD4	U15.W40	U21.35
DDR_7B_ADD5	U15.W39	U21.36
DDR_7B_ADD6	U15.W38	U21.37
DDR_7B_ADD7	U15.V38	U21.38
DDR_7B_ADD8	U15.U41	U21.39
DDR_7B_ADD9	U15.U40	U21.40
DDR_7B_ADD10	U15.U39	U21.28
DDR_7B_ADD11	U15.U38	U21.41
DDR_7B_ADD12	U15.T38	U21.42
DDR_7B_ADD13	U15.R40	U21.17
DDR_7B_DATA0	U15.AA33	U21.2
DDR_7B_DATA1	U15.AA34	U21.4
DDR_7B_DATA2	U15.Y31	U21.5
DDR_7B_DATA3	U15.Y32	U21.7
DDR_7B_DATA4	U15.Y36	U21.8
DDR_7B_DATA5	U15.Y37	U21.10
DDR_7B_DATA6	U15.Y33	U21.11

Signal Name	FPGA Pin	DDR SDRAM
DDR_7B_DATA7	U15.Y34	U21.13
DDR_7B_DATA8	U15.W33	U21.54
DDR_7B_DATA9	U15.W34	U21.56
DDR_7B_DATA10	U15.V31	U21.57
DDR_7B_DATA11	U15.U32	U21.59
DDR_7B_DATA12	U15.V32	U21.60
DDR_7B_DATA13	U15.V33	U21.62
DDR_7B_DATA14	U15.U31	U21.63
DDR_7B_DATA15	U15.T31	U21.65
DDR_FPGA_7B_UDQS	U15.V36	U21.51
DDR_FPGA_7B_LDQS	U15.Y40	U21.16
DDR_FPGA_7B_UDM	U15.U34	U21.47
DDR_FPGA_7B_LDM	U15.W32	U21.20
DDR_FPGA_7B_BA0	U15.U36	U21.26
DDR_FPGA_7B_BA1	U15.U37	U21.27
DDR_FPGA_7B_CASn	U15.R41	U21.22
DDR_FPGA_7B_CKE	U15.T36	U21.44
DDR_FPGA_7B_CSn	U15.T39	U21.24
DDR_FPGA_7B_RASn	U15.T37	U21.23
DDR_FPGA_7B_WEn	U15.R42	U21.21

7 Rocket IO Transceivers

RocketIO transceivers are an exciting new feature of the Virtex-II Pro family. These multigigabit transceivers (MGTs) can transmit data at speeds from 622 Mb/s up to 3.125 Gb/s (determined be the speed grade of the part, please refer to the Xilinx datasheet). MGTs are capable of various high-speed serial standards such as Gigabit Ethernet, FiberChannel, InfiniBand, and XAUI. In addition, the channel-bonding feature aggregates multiple channels, allowing for even higher data transfer rates. For additional information on RocketIO transceivers, see the *RocketIO Transceiver User Guide* at: http://www.xilinx.com/publications/products/v2pro/userguide/ug024.pdf

The ET6000K10S board has 10 RocketIO transceivers available on the top side of the FPGA. These 10 transceivers implement three different MGT interfaces on board,

including four Gigabit Ethernet Fiber channels, two InfiniBand channels, and two Serial ATA channels, one configured as a Serial ATA Host, the other configured as a Serial ATA Device (peripheral) and two SMA interfaces.

7.1 Gigabit Ethernet Fiber

Gigabit Ethernet fiber represents a marked evolution over copper Gigabit Ethernet, allowing signals to be transmitted 500 meters (multi-mode) or as much as 10km (singlemode). In addition, it provides for high tolerance of EMI, and, in turn, produces little EMI.

7.1.1 Stratos Lightwave Quad Fiber Transceiver (J3)

While the Virtex-II Pro can deliver the speeds required by Gigabit Ethernet, it is not capable of transmitting or receiving optical signals directly. This capability is added by the inclusion of Stratos Lightwave R14K-ST11 Quad Gigabit Ethernet Transceivers. The R14KST11 is a 4-port multimode transceiver, capable of transmitting approximately 550 meters (about 1/3 of a mile). The R14K-ST11 pinout is shown in Table 24.

Table 24 - Pinout of R14K-ST11 Gigabit Fiber Transceiver

Pin Number	Symbol	Description	Logic Family
GP	GP	Grounding Posts. Connect to signal ground	N.A.
1, 11, 21, 31	TD+	Transmitter DATA In	LVPECL
2, 12, 22, 32	VEETX	Transmitter Signal Ground	N/A
3, 13, 23, 33	TD-	Transmitter DATA In	LVPECL
4, 14, 24, 34	VCCTX	Transmitter Power Supply	N/A
5, 15, 25, 35	SD	Signal Detect Satisfactory Optical Input: Logic "1" Output Fault Condition: Logic "0" Output	LVTTL
6, 16, 26, 36	TDIS	Transmit Disable	LVTTL
7, 17, 27, 37	RD+	Receiver DATA Out	LVPECL
8, 18, 28, 38	VCCRX	Receiver Power Supply	N/A
9, 19, 29, 39	RD-	Receiver DATA Out	LVPECL
10, 20, 30, 40	VEERX	Receiver Signal Ground	N/A

7.1.2 FPGA to Transceiver

The connections between the transceiver are made using AC-coupling capacitors on the receive paths. In addition, there are 180 ohm pull-downs on the receive side to convert from the LVPECL signaling standards used by the fiber transceivers. The Stratos Lightwave recommended connectivity for the T14K-ST11 Gigabit Ethernet Transceiver is shown in Table 25.

The connections from the FPGA to the Gigabit Ethernet Fiber transceiver are based on this figure. The AC-coupling capacitor value of 0.1 µF provides for less than 4 ps of pattern dependent jitter (PDJ) for run-lengths of 72 or less.

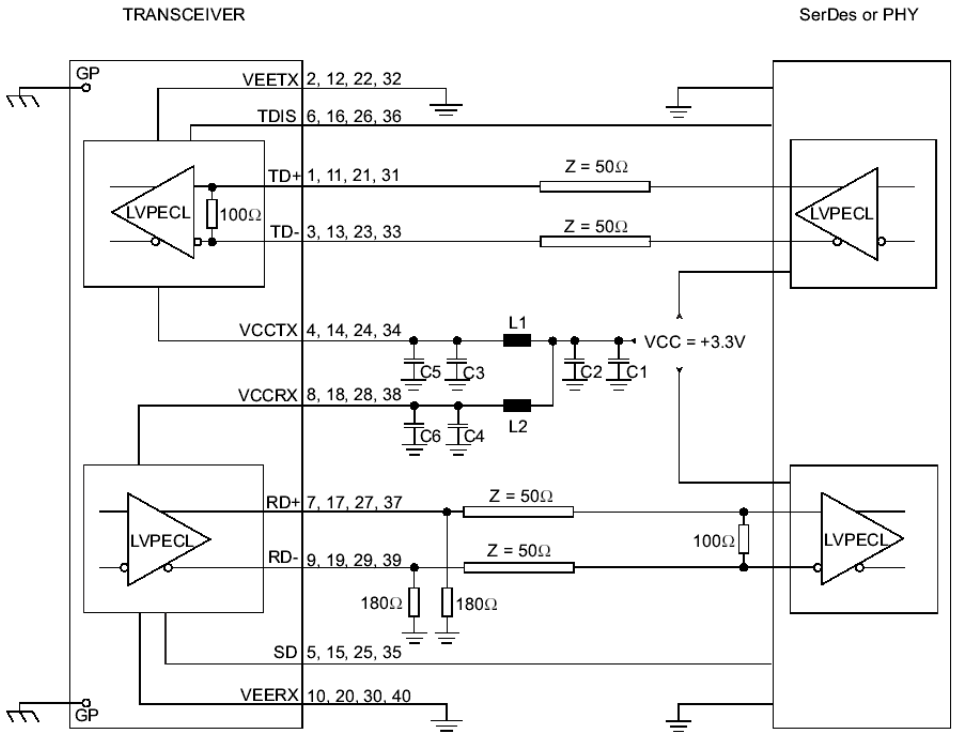


Figure 58 - Recommended connections for the R14K-ST11

Table 3 details the connection between the FPGA and the R14K-ST11 Gigabit Ethernet Transceiver, showing the pins used on the FPGA and the R14K-ST11.

Table 25 - Connections between FPGA and R14K-ST11 Gig-E Fiber

Signal Name	FPGA Pin	R14-ST11 Pin
GIGE0_TxP	U15.A16	J3.1
GIGE0_TxN	U15.A17	J3.3

Signal Name	FPGA Pin	R14-ST11 Pin
GIGE0_RxP	U15.A15	J3.7
GIGE0_RxN	U15.A14	J3.9
GIGE1_TxP	U15.A12	J3.11
GIGE1_TxN	U15.A13	J3.13
GIGE1_RxP	U15.A11	J3.17
GIGE1_RxN	U15.A10	J3.19
GIGE2_TxP	U15.A8	J3.21
GIGE2_TxN	U15.A9	J3.23
GIGE2_RxP	U15.A7	J3.27
GIGE2_RxN	U15.A6	J3.29
GIGE3_TxP	U15.A4	J3.31
GIGE3_TxN	U15.A5	J3.33
GIGE3_RxP	U15.A3	J3.37
GIGE3_RxN	U15.A2	J3.39

7.2 Infiniband/HSSCD2

The InfiniBand Architecture is a high-speed point-to-point serial connection standard. These links can operate three levels of link performance - 2.5 Gbps, 10 Gbps, and 30 Gbps. The 2.5 Gbps connection it within the range of operation of the Virtex-II Pro RocketIO. For more information about InfiniBand, see

http://www.infinibandta.org/home

7.2.1 FPGA to InfiniBand/HSSDC2 Connector

The connection between the FPGA and the InfiniBand/HSSDC2 connector is fairly simple, involving only four wires per connector, as well as a few discrete components to provide for AC-coupling of the signals. These connections are shown in Table 26.

Table 26- Connections between FPGA and Infniband/HSSDC2

Signal Name	FPGA Pin	Connector
IB0__TxP	U15.A20	J4.6
IB0__TxN	U15.A21	J4.5
IB0__RxP	U15.A19	J4.2

Signal Name	FPGA Pin	Connector
IB0__RxN	U15.A18	J4.3
IB1__TxP	U15.A24	J6.6
IB1__TxN	U15.A25	J6.5
IB1__RxP	U15.A23	J6.2
IB1__RxN	U15.A22	J6.3

The InfiniBand connectors have different connections to the FPGA for transmit and receive differential pairs. The receive differential pair between the FPGA and the InfiniBand/HSSDC2 connector is connected by way of a 0.01 µF capacitor. This capacitor AC-couples the incoming signal to the FPGA. The transmit differential pair between the FPGA and the InfiniBand/HSSDC2 connector is connected by way of a 0 resistor. The resistor is used as a placeholder to allow for AC-coupling, if desired at a future date.

7.3 Serial ATA

Serial ATA is the next generation of the ATA family of interfaces. Providing a higher throughput through a simpler and less expensive cable, Serial ATA maintains software compatibility with older ATA implementations.

7.3.1 FPGA to Serial ATA Connector

The ET6000K10S board provides for operation as a Serial ATA host or device. The connection between the FPGA and the Serial ATA connector is fairly simple, involving only four wires per connector, as well as a few capacitors and resistors to AC-couple the signals. These connections are also shown in Table 27.

Table 27 - Connections between FPGA and SATA

Signal Name	FPGA Pin	Connector
SA0__TxP	U15.A28	J7.6
SA0__TxN	U15.A29	J7.5
SA0__RxP	U15.A27	J7.2
SA0__RxN	U15.A26	J7.3
SA1__TxP	U15.A32	J8.6
SA1__TxN	U15.A33	J8.5
SA1__RxP	U15.A31	J8.2
SA1__RxN	U15.A30	J8.3

The Serial ATA connectors have different connections to the FPGA for transmit and receive differential pairs. The receive differential pair is connected by way of a 0.01µF capacitor to AC-couple the incoming signal to the FPGA. The transmit differential pair between the FPGA and the Serial ATA connector is connected by way of a 0 resistor. The resistor is a placeholder to allow for AC-coupling if required at a future date. The ML300 provides for operation as a Serial ATA host or device.

7.4 SMA Connectors

The SMA connectors allow for direct connection the FPGA MGT interfaces.

7.4.1 FPGA to SMA Connector

The ET6000K10S board provides two discrete MGT channels. The connection between the FPGA and the SMA connectors is fairly simple, involving only one wire per connector, as well as a few capacitors and resistors to AC-couple the signals. These connections are also shown in Table 28.

Table 28 - Connections between FPGA and SMA Connectors

Signal Name	FPGA Pin	Connector
SMA1__TxP	U15.A40	J10
SMA1__TxN	U15.A41	J12
SMA1__RxP	U15.A39	J9
SMA1__RxN	U15.A38	J11
SMA2__TxP	U15.A36	J15
SMA2__TxN	U15.A37	J18
SMA2__RxP	U15.A35	J14
SMA2__RxN	U15.A34	J17

Please note the RocketIO Tranceiver performance in Table 29:

Table 29 - RocketIO Performance

Item	Speed Grade			Units
	-7	-6	-5	
RocketIO Tranceiver (FF)	2.5	2.5	2.0	Gb/s
PowerPC Processor Block	400	350	300	MHz

8 CPU Debug and CPU Trace

The ET6000K10S board includes two CPU debugging interfaces, the CPU Debug (JP3 is a vertical header) and the Combined CPU Trace and Debug, (J5 is a vertical mictor connector). These connectors can be used in conjunction with third party tools, or in some cases the Xilinx Parallel Cable IV, to debug software as it runs on the processor.

The PowerPC™ 405 CPU core includes dedicated debug resources that support a variety of debug modes for debugging during hardware and software development. These debug resources include:

- Internal debug mode for use by ROM monitors and software debuggers
- External debug mode for use by JTAG debuggers
- Debug wait mode, which allows the servicing of interrupts while the processor appears to be stopped
- Real-time trace mode, which supports event triggering for real-time tracing

Debug modes and events are controlled using debug registers in the processor. The debug registers are accessed either through software running on the processor or through the JTAG port. The debug modes, events, controls, and interfaces provide a powerful combination of debug resources for hardware and software development tools.

The JTAG port interface supports the attachment of external debug tools, such as the ChipScope™ Integrated Logic Analyzer, a powerful tool providing logic analyzer capabilities for signals inside an FPGA, without the need for expensive external instrumentation. Using the JTAG test access port, a debug tool can single-step the processor and examine the internal processor state to facilitate software debugging. This capability complies with the IEEE 1149.1 specification for vendor-specific extensions and is, therefore, compatible with standard JTAG hardware for boundary-scan system testing.

8.1 CPU Debug

External-debug mode can be used to alter normal program execution. It provides the ability to debug system hardware as well as software. The mode supports multiple functions: starting and stopping the processor, single-stepping instruction execution, setting breakpoints, as well as monitoring processor status. Access to processor resources is provided through the CPU Debug port.

The PPC405 JTAG (Joint Test Action Group) Debug port complies with IEEE standard 1149.1-1990, IEEE Standard Test Access Port and Boundary Scan

Architecture. This standard describes a method for accessing internal chip resources using a four-signal or five-signal interface. The PPC405 JTAG Debug port supports scan-based board testing and is further enhanced to support the attachment of debug tools. These enhancements comply with the IEEE 1149.1 specifications for vendor-specific extensions and are compatible with standard JTAG hardware for boundary-scan system testing.

The PPC405 JTAG debug port supports the four required JTAG signals: TCK, TMS, TDI, and TDO. It also implements the optional TRST signal. The frequency of the JTAG clock signal can range from 0 MHz (DC) to one-half of the processor clock frequency. The JTAG debug port logic is reset at the same time the system is reset, using TRST. When TRST is asserted, the JTAG TAP controller returns to the test-logic reset state.

Refer to the *PPC405 Processor Block Manual* for more information on the JTAG debug-port signals. Information on JTAG is found in the IEEE standard 1149.1-1990.

8.1.1 CPU Debug Connector

Figure 59 shows JP3, the vertical header used to debug the operation of software in the CPU. This is done using debug tools such as Parallel Cable IV or third party tools. This connector cannot be used when the Mictor connector is in use.

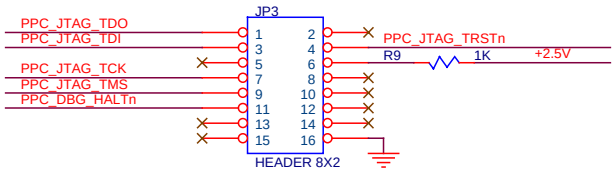


Figure 59 - CPU Debug Connector

8.1.2 CPU Debug Connection to FPGA

The connection between the CPU debug connector and the FPGA are shown in Table 30. These signals are attached to the PowerPC™ 405 JTAG debug resources using normal FPGA routing resources. The JTAG debug resources are not hard-wired to particular pins, and are available for attachment in the FPGA fabric, making it is possible to route these signals to whichever FPGA pins the user would prefer to use.

Table 30 - CPU Debug connection to FPGA

Signal Name	FPGA Pin	Connector
PPC_JTAG_TDO	U15.D24	JP3.1
PPC_JTAG_TDI	U15.C23	JP3.3
PPC_JTAG_TRSTn	U5.79	JP3.4
PPC_JTAG_TCK	U15.D23	JP3.7

Signal Name	FPGA Pin	Connector
PPC_JTAG_TMS	U15.C24	JP3.7
PPC_DBG_HALTn	U15.E23	JP3.7

8.1.3 CPU Trace

The CPU Trace port accesses the real-time, trace-debug capabilities built into the PowerPC™ 405 CPU core. Real-time trace-debug mode supports real-time tracing of the instruction stream executed by the processor. In this mode, debug events are used to cause external trigger events. An external trace tool uses the trigger events to control the collection of trace information. The broadcast of trace information occurs independently of external trigger events (trace information is always supplied by the processor).

Real-time trace-debug does not affect processor performance. Real-time trace-debug mode is always enabled. However, the trigger events occur only when both internal-debug mode and external debug mode are disabled. Most trigger events are blocked when either of those two debug modes is enabled. Information on the trace-debug capabilities, how trace-debug works, and how to connect an external trace tool is available in the *RISCWatch Debugger User's Guide*.

8.1.4 CPU Trace Connector

Agilent/Windriver has defined a Trace Port Analyzer (TPA) port for the PowerPC 4xx line of CPU cores that combines the CPU Trace and the CPU Debug interfaces onto a single 38-pin Mictor connector. This provides for high-speed, controlled-impedance signaling.

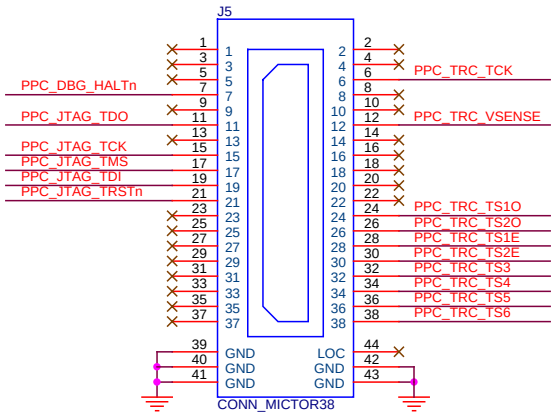


Figure 60 - Combined Trace/Debug Connector Pinout

8.1.5 Combined CPU Trace/Debug Connection to FPGA

Table 31 shows the connection between the Combined CPU Trace and Debug Port (J5). The connections to the FPGA are shared with the CPU Trace and CPU Debug interfaces discussed in previous sections.

Table 31 - Combined CPU Trace/Debug connection to FPGA

Signal Name	FPGA Pin	Connector
PPC_TRC_TCK	U15.E24	JP5.6
PPC_DBG_HALTn	U15.E23	JP5.7
PPC_TRC_VSENSE	N.A.	JP5.12
PPC_JTAG_TDO	U15.D24	JP5.11
PPC_JTAG_TCK	U15.D23	JP5.15
PPC_JTAG_TMS	U15.C24	JP5.17
PPC_JTAG_TDI	U15.C23	JP5.19
PPC_JTAG_TRSTn	U5.79	JP5.21
PPC_TRC_TS1O	U15.F20	JP5.24
PPC_TRC_TS2O	U15.F19	JP5.26
PPC_TRC_TS1E	U15.E20	JP5.28
PPC_TRC_TS2E	U15.E19	JP5.30
PPC_TRC_TS3	U15.D20	JP5.32
PPC_TRC_TS4	U15.D19	JP5.34
PPC_TRC_TS5	U15.C20	JP5.36
PPC_TRC_TS6	U15.C19	JP5.38

9 GPIO LED's

9.1 Status Indicators

The ET6000K10S uses DS1 and DS2 to visually indicate the status of the board. DS1 is controller by the MCU (U4) and the CPLD (U5) controls DS2.

Table 32 lists the function of the GPIO LED's. The LED's is number from left to right LED0 to LED7.

Table 32 - GPIO LED's

Signal Name	Device	LED	Description
MCU_LED0n	U4.14	DS1.0	Indicates SmartMedia configuration passed
MCU_LED1n	U4.15	DS1.1	Indicates invalid SmartMedia card
MCU_LED2n	U4.16	DS1.2	Indicates configuration error
MCU_LED3n	U4.17	DS1.3	Indicates data transfer in progress from SmartMedia to the FPGA
CPLD_LED0n	U5.17	DS2.1	Indicates FPGA is not configured
CPLD_LED1n	U5.19	DS2.2	Indicates board reset
CPLD_LED2n	U5.130	DS2.3	Indicates RoboClock PLL #1 (U25) is in lock
CPLD_LED3n	U5.131	DS2.4	Indicates RoboClock PLL #2 (U26) is in lock

9.2 FPGA GPIO LED's

The ET6000K10S provides 10 GPIO LED's directly connected to the FPGA IO pins. Table 33 lists the FPGA GPIO LED's on the ET6000K10S and is available to the user. The signals are active LOW.

Table 33 – FPGA GPIO LED's

Signal Name	FPGA	LED
LED0	U15.AR30	DS6

Signal Name	FPGA	LED
LED1	U15.AT30	DS7
LED2	U15.AN30	DS8
LED3	U15.AP30	DS9
LED4	U15.AL30	DS12
LED5	U15.AM30	DS13
LED6	U15.AT31	DS14
LED7	U15.AP31	DS15
LED8	U15.AR31	DS4
LED9	U15.AM31	DS5

10 PCI Interface

Peripheral Component Interconnect (PCI) Local Bus is a bus standard that is a mainstay of many different computer systems. PCI is a high-performance bus with multiplexed address and data lines. Defined for both 32-bit and 64-bit wide data buses, PCI is intended for use as an interconnect mechanism between highly integrated peripheral controller components, peripheral add-in boards, and processor/memory systems. The ET6000K10S can be hosted in a 32-bit or 64-bit PCI/PCI-X slot and includes two main components:

- FPGA as the PCI bus Master
- PCI Edge Connector

Virtex-II Pro parts does not tolerate +5V signaling, so the ET6000K10S must be plugged into a +3.3V PCI slot (PCI-X, by definition, is +3.3V signaling). The PWB is keyed so that it is not possible to mistakenly plug the board into a +5V PCI slot. Do **NOT** grind out the key in the PCI host slot, and do **NOT** modify the ET6000K10S to get it to fit into the slot. If you need a +3.3V PCI slot, the ETPCIEXT-S3 Extender card can perform this function. Please refer to Emulation Technology website. The extender also has the capability to slow the clock frequency of the PCI bus by a factor of two - function that is very useful when prototyping ASIC's.

The +3.3V power on the PCI connector is not used. Instead, +3.3V is generated from the 5V supply.

10.1 Connection to the FPGA

The FPGA connections to the PCI bus consist of 91 signals spread across two banks, Bank 4 and Bank 5. A description of these signals can be found are in the following sections.

> Note: The PCI interface is not 5V tolerant. Do not modify the PCI edge connector to fit in the host PC.

10.1.1 PCI VCCO on the FPGA

A Linear Technology LTC1763 regulator (refer to Figure 61) is used to ensure electrical compatibility to PCI and to protect the Virtex-II Pro from over-voltage conditions. It is used for the VCCO of the banks connected to the PCI interface. For more information, see XAPP653: Virtex-II Pro PCI Reference Design at:

http://www.xilinx.com/xapp/xapp653.pdf.

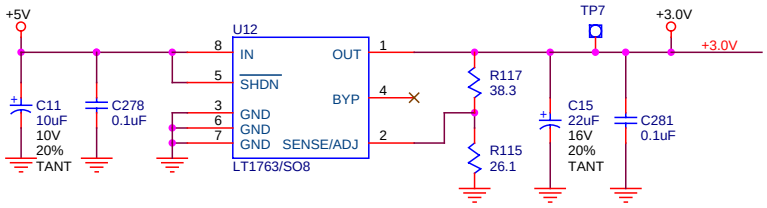
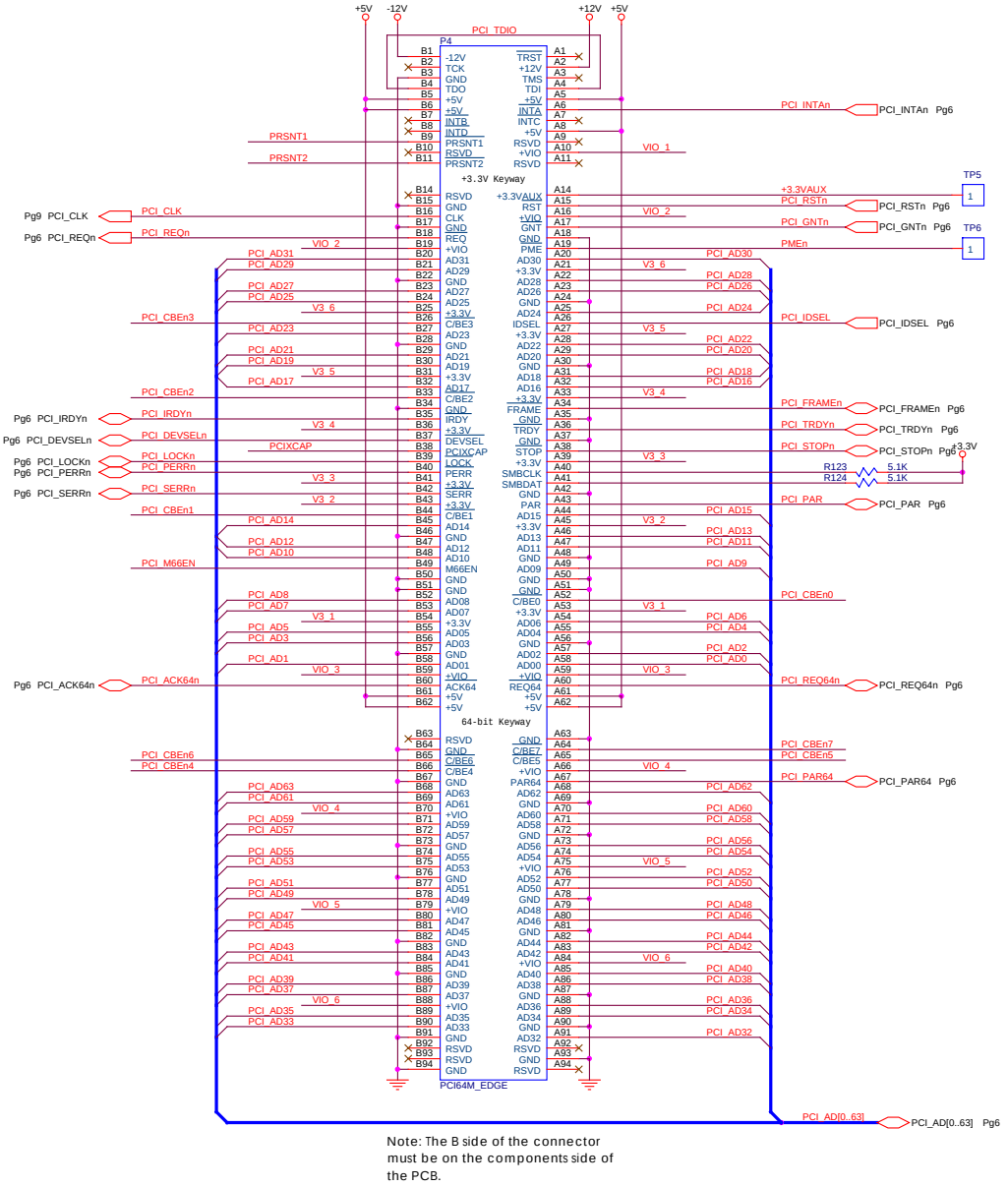


Figure 61 - VirtexII Pro PCI VCCO Regulator

10.1.2 PCI Edge Connector

Figure 62 shows P4, the PCI 3.3V 64- Bit edge connector used to interface with the host PC.



Note: The B side of the connector must be on the components side of the PCB.

Figure 62 - PCI Edge Connector

10.1.3 Connection between the PCI connector and the FPGA

Table 34 shows the connection between the PCI Edge Connector and the FPGA. The VCCO of the banks are connected to +3.0V.

Table 34 - PCI to FPGA Connections

Signal Name	Connector	FPGA Pin
PCI_AD0	P4.A58	U15.AU20

Signal Name	Connector	FPGA Pin
PCI_AD1	P4.B58	U15.AW23
PCI_AD2	P4.A57	U15.AR20
PCI_AD3	P4.B56	U15.AV23
PCI_AD4	P4.A55	U15.AU19
PCI_AD5	P4.B55	U15.AY20
PCI_AD6	P4.A54	U15.AT19
PCI_AD7	P4.B53	U15.AW20
PCI_AD8	P4.B52	U15.AV20
PCI_AD9	P4.A49	U15.AT18
PCI_AD10	P4.B48	U15.AY19
PCI_AD11	P4.A47	U15.AR18
PCI_AD12	P4.B47	U15.AW19
PCI_AD13	P4.A46	U15.AU17
PCI_AD14	P4.B45	U15.AV19
PCI_AD15	P4.A44	U15.AT17
PCI_AD16	P4.A32	U15.AU15
PCI_AD17	P4.B32	U15.AY15
PCI_AD18	P4.A31	U15.AU13
PCI_AD19	P4.B30	U15.AV15
PCI_AD20	P4.A29	U15.AT13
PCI_AD21	P4.B29	U15.AY14
PCI_AD22	P4.A28	U15.AR13
PCI_AD23	P4.B27	U15.AY13
PCI_AD24	P4.A25	U15.AU12
PCI_AD25	P4.B24	U15.AV13
PCI_AD26	P4.A23	U15.AT12
PCI_AD27	P4.B23	U15.AW12
PCI_AD28	P4.A22	U15.AV11
PCI_AD29	P4.B21	U15.AY11

Signal Name	Connector	FPGA Pin
PCI_AD30	P4.A20	U15.AU11
PCI_AD31	P4.B20	U15.AY10
PCI_AD32	P4.A91	U15.AV33
PCI_AD33	P4.B90	U15.AY33
PCI_AD34	P4.A89	U15.AU33
PCI_AD35	P4.B89	U15.AW33
PCI_AD36	P4.A88	U15.AV32
PCI_AD37	P4.B87	U15.AY32
PCI_AD38	P4.A86	U15.AU32
PCI_AD39	P4.B86	U15.AW31
PCI_AD40	P4.A85	U15.AV31
PCI_AD41	P4.B84	U15.AY30
PCI_AD42	P4.A83	U15.AU31
PCI_AD43	P4.B83	U15.AW30
PCI_AD44	P4.A82	U15.AV30
PCI_AD45	P4.B81	U15.AY29
PCI_AD46	P4.A80	U15.AU30
PCI_AD47	P4.B80	U15.AY28
PCI_AD48	P4.A79	U15.AV28
PCI_AD49	P4.B78	U15.AW27
PCI_AD50	P4.A77	U15.AU28
PCI_AD51	P4.B77	U15.AV27
PCI_AD52	P4.A76	U15.AU27
PCI_AD53	P4.B75	U15.AY26
PCI_AD54	P4.A74	U15.AT27
PCI_AD55	P4.B74	U15.AW26
PCI_AD56	P4.A73	U15.AU26
PCI_AD57	P4.B72	U15.AV26
PCI_AD58	P4.A71	U15.AT26

Signal Name	Connector	FPGA Pin
PCI_AD59	P4.B71	U15.AY25
PCI_AD60	P4.A70	U15.AT25
PCI_AD61	P4.B69	U15.AV25
PCI_AD62	P4.A68	U15.AU24
PCI_AD63	P4.B68	U15.AY24
PCI_CBEN0	P4.A52	U15.AR19
PCI_CBEN1	P4.B44	U15.AY18
PCI_CBEN2	P4.B33	U15.AV16
PCI_CBEN3	P4.B26	U15.AW13
PCI_CBEN4	P4.B66	U15.AW24
PCI_CBEN5	P4.A65	U15.AR24
PCI_CBEN6	P4.B65	U15.AV24
PCI_CBEN7	P4.A64	U15.AU23
PCI_CLK	P4.B16	U15.AU21
PCI_DEVSELn	P4.B37	U15.AV17
PCI_FRAMEn	P4.A34	U15.AR16
PCI_GNTn	P4.A17	U15.AV10
PCI_IDSEL	P4.A26	U15.AV12
PCI_INTAn	P4.A6	U15.AU10
PCI_IRDYn	P4.B35	U15.AW16
PCI_LOCKn	P4.B39	U15.AW17
PCI_PAR	P4.A43	U15.AT24
PCI_PAR64	P4.A67	U15.AR17
PCI_PERRn	P4.B40	U15.AY17
PCI_REQ64n	P4.A60	U15.AR23
PCI_ACK64n	P4.B60	U15.AY23
PCI_REQn	P4.B18	U15.AW10
PCI_RSTn	P4.A15	U15.AP20
PCI_SERRn	P4.B42	U15.AV18

Signal Name	Connector	FPGA Pin
PCI_STOPn	P4.A38	U15.AU16
PCI_TRDYn	P4.A36	U15.AT16

10.2 PCI/PCI-X Hardware Setup

The following section describes the PCI/PCI-X hardware setup. More information is available from the PCI/PCI-X Specifications, available from PCI-SIG: http://www.pcisig.com/home.

10.2.1 Present Signals

The Present signals indicate to the system board whether an add-in card is physically present in the slot and, if one is present, the total power requirements of the add-in card (refer to Table 35).

Table 35 - Present Signal Definition

PRSNT1#	PRSNT2#	Add-in Card Configuration
Open	Open	No add-in card present
Ground	Open	Add-in card present, 25 W maximum
Open	Ground	Add-in card present, 15 W maximum
Ground	Ground	Add-in card present, 7.5 W maximum

The ET6000K10S is factory configured for 25W power setting (JP1.1-2 and JP1.3-4, jumpers installed).

10.2.2 M66EN and PCIXCAP Encoding

The 66MHZ_ENABLE pin indicates to a device whether the bus segment is operating at 66 or 33 MHz. Add-in cards indicate whether they support PCI-X, and if so which frequency, by the way they connect one pin called PCIXCAP (refer to Figure 63).

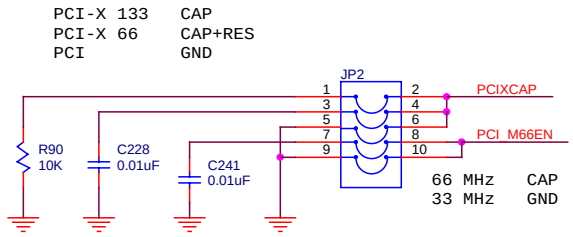


Figure 63 - M66EN and PCIXCAP Jumper

If the card's maximum frequency is 133 MHz, it leaves this pin unconnected (except for a decoupling capacitor). If the card's maximum frequency is 66 MHz, it connects PCIXCAP to ground through a resistor (and decoupling capacitor). Conventional cards connect this pin to ground. An add-in card indicates its capability with one of the combinations of the M66EN and PCIXCAP pins listed in Table 36.

Table 36 - M66EN and PCIXCAP Encoding

M66EN	PCIXCAP	Conventional Device Frequency Capability	PCI-X Device Frequency Capability
Ground	Ground	33 MHz	Not capable
Not connected	Ground	66 MHz	Not capable
Ground	Pull-down	33 MHz	PCI-X 66 MHz
Not connected	Pull-down	66 MHz	PCI-X 66 MHz
Ground	Not connected	33 MHz	PCI-X 133 MHz
Not connected	Not connected	66 MHz	PCI-X 133 MHz

The ET6000K10S is factory configured to operate in PCI mode at 33MHz (JP2.5-6 and JP2.9-10, jumpers installed).

10.2.3 Further Information on PCI/PCI-X Signals

The following signals have pull-up resistors (1M) on the ET6000K10S. This is technically a violation of the PCI specification, but there are systems that have these signals floating:

- PCI_LOCKn
- PCI_REQ64n
- PCI_ACK64n

Note: The function of LOCKn pin was deleted in version 2.3 of the PCI Specification. The PCI JTAG signals TDI, TDO, TCK, TRSTn, are not used. TDI and TDO are connected together per the PCI Specification to maintain JTAG chain integrity on the motherboard. The signals TMS, TCK, and TRSTn are left unconnected.

The following signals are not connected on the ET6000K10S:

- +3.3VAUX
- INTBn, INTCn, INTDn

11 Power System

The ET6000K10S supports a wide range of technologies, from legacy devices like serial ports, to DDR SDRAM and RocketIO multi-gigabit transceivers (MGTs). This wide range of technologies requires a wide range of power supplies. These are provided on the ET6000K10S using a combination of switching and linear power regulators.

The ET6000K10S can be hosted in a +3.3V PCI/PCI-X slot, or it can be used in a standalone configuration. During in-system operation, the primary supply to the ET6000K10S secondary supplies is derived from the PCI +5V fingers, while in standalone operation the primary power to the ET6000K10S is derived from an external ATX type power supply.

11.1 In-System Operation

Power is supplied to all the secondary supplies on the ET6000K10S from the PCI +5V fingers. The PCI +3.3V is not used and the user should not connect this supply to the power grid. During in-system operation, the ET6000K10S has the following power supplies:

- +1.5V
- +2.5V
- +3.3V
- +5V
- +12V
- -12V

The +1.5V, +2.5V, and +3.3V power supplies are generated from the +5V supply using the DATEL power modules (U28, U29, U30). These modules are non-isolated, 300kHz-switching regulators, rated for 10A and provide clean power to the ET6000K10S (please refer to datasheet for more information). The +5V (rated for 25W as per PCI Specification), +12V, and –12V is obtained from the PCI fingers.

11.2 Stand Alone Operation

The ET6000K10S can be used standalone, meaning it doesn't have to be plugged into a PCI slot. An external ATX power supply is used to supply power to the ET6000K10S in this configuration (refer to Figure 64). The external power supply connects to header P12, a Tyco disk drive type of connector.

During standalone operation, the ET6000K10S has the following power supplies:

- +1.5V
- +2.5V
- +3.3V
- +5V
- +12V

The +1.5V, +2.5V, and +3.3V power supplies are generated from the +5V supply using the External ATX power supply.

Figure 64 - ATX Power Supply

Any ATX type power supply is adequate. Emulation Technology recommends a power supply rated for 250W. Note: The switching regulators in the Power Supply may require and external load to operate within specifications (the ET6000K10S may not meet the minimum load requirements). Emulation Technology recommends attaching an old disk drive to one of the spare connectors.

11.2.1 External Power Connector

Figure 65 indicates the connections to the external power connector. This header is fully polarized to prevent reverse connection and is rated for 250VAC at 13A.

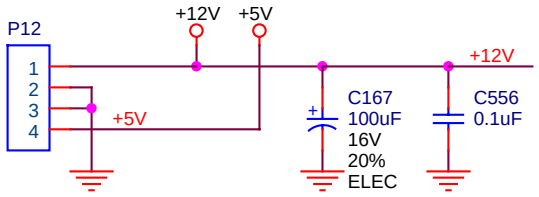


Figure 65 - External Power Connection

Note: Header P12 is not hot-plug able. Do not attach power while power supply is ON.

11.2.2 Power Monitors

Two triple supply monitors (U1, U2) are used to monitor the +1.5V, +2.5V, and +3.3V supplies (for more information on these devices, please refer to the datasheet for the LT1326 from Linear Technology). These power supply monitors also provide a push-button reset input that is utilized to reset the various sub-circuits of the ET6000K10S. After power-up PWRRSTn remains asserted for approximately 200ms.

11.2.3 Power Indicators

There are six LED's on the ET6000K10S used to indicates the presence of the following voltage sources (refer to Table 37):

Table 37 - Voltage Indicators

Voltage Source	LED
+2.5V	DS20
+3.0V (used for PCI only)	DS3
+3.3V	DS19
+5V	DS18
+12V	DS16
-12V	DS17

12 Test Header & Daughter Card Connections

12.1 Test Header

The ET6000K10S offers one 200-pin test header (P11) that allows the user connection to discrete FPGA pins (refer to Figure 66).

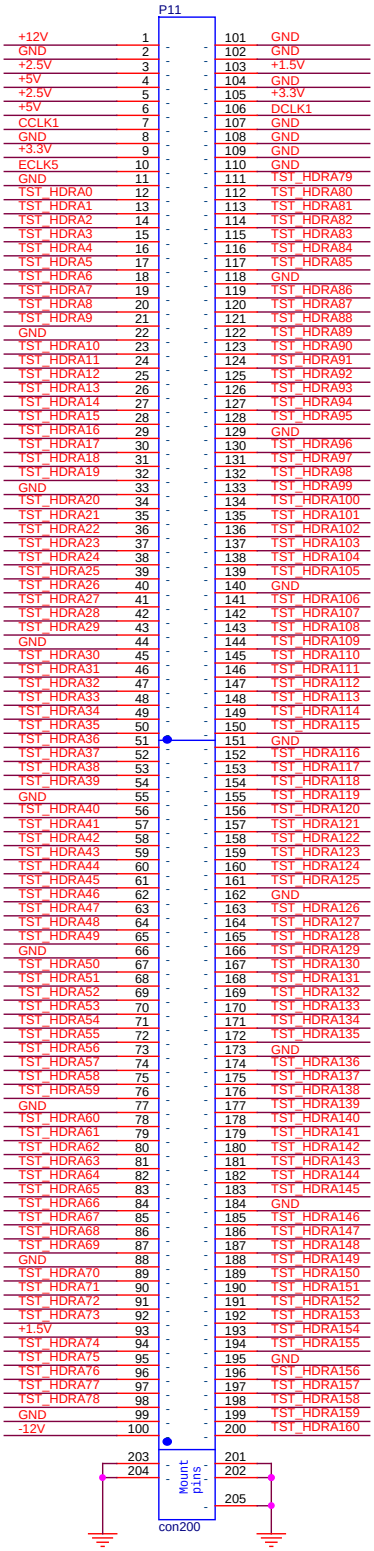


Figure 66 - Test Header

12.1.1 Test Header Connector

Micropax connector (200 pin) is used as a standard interface to all Emulation Technology logic emulation boards. This connector has a specified current rating of 0.5 amps per contact. See datasheet for more information P/N 91294-003.

12.1.2 Test Header Pin Numbering

Figure 67 indicates the pin numbering scheme used on the test headers.

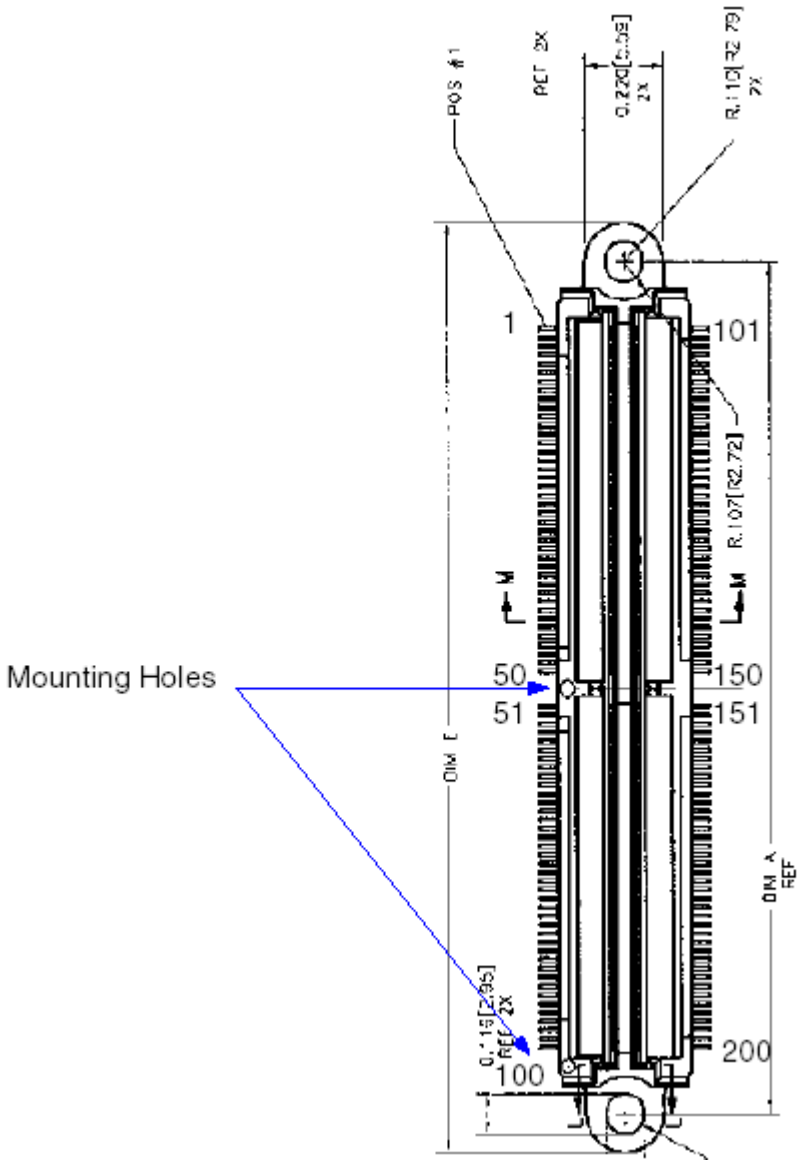


Figure 67 - Test Header Pin Numbering

12.2 ET3000K10SD Daughter Card

Emulation Technology manufactures a daughter "ET3000K10SD" card that allows the user connection to the FPGA IO pins. The daughter card has the following features:

- Buffered I/O, Passive and Active Bus Drivers
- Unbuffered I/O
- Differential LVDS pairs (Note: Not available on ET6000K10S Logic Emulation board)
- Headers for Test Points

The daughter card contains headers that may be useful with certain types of oscilloscope probes, or when wiring pins to prototype areas. Figure 68 is a block diagram of the daughter card.

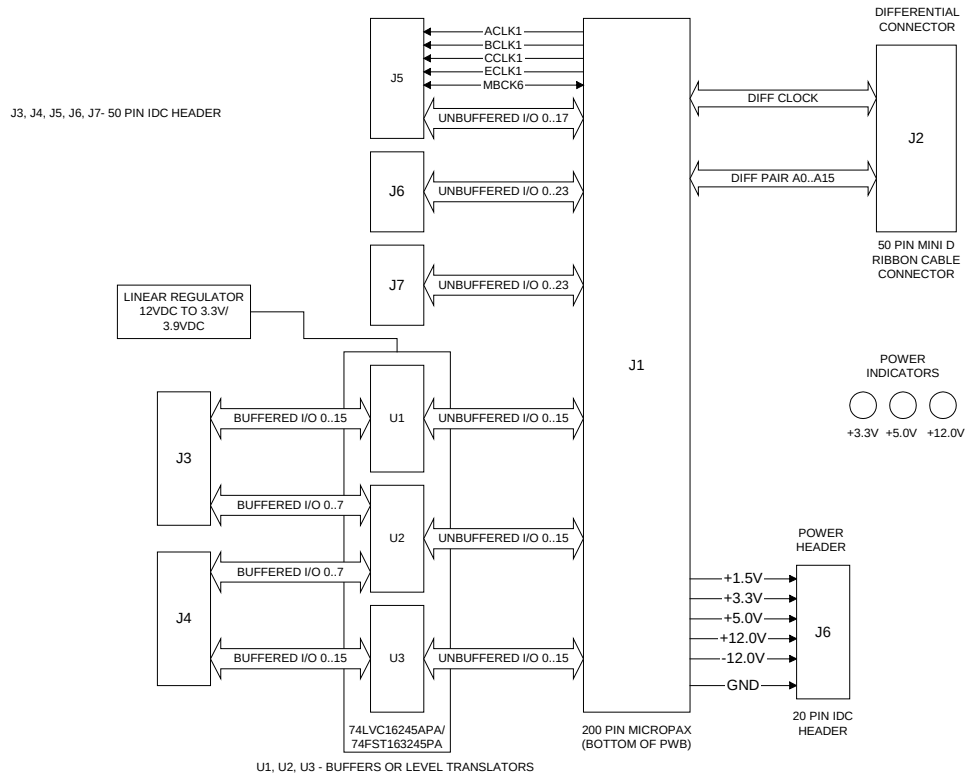


Figure 68 - ET3000K10SD Daughter Card Block Diagram

The ET3000K10SD Daughter Card provides 16-differential pairs, 48-buffered (passive/active) I/O, and 66-unbuffered I/O signals. The ET3000K10SD Daughter Card is pictured in Figure 69.

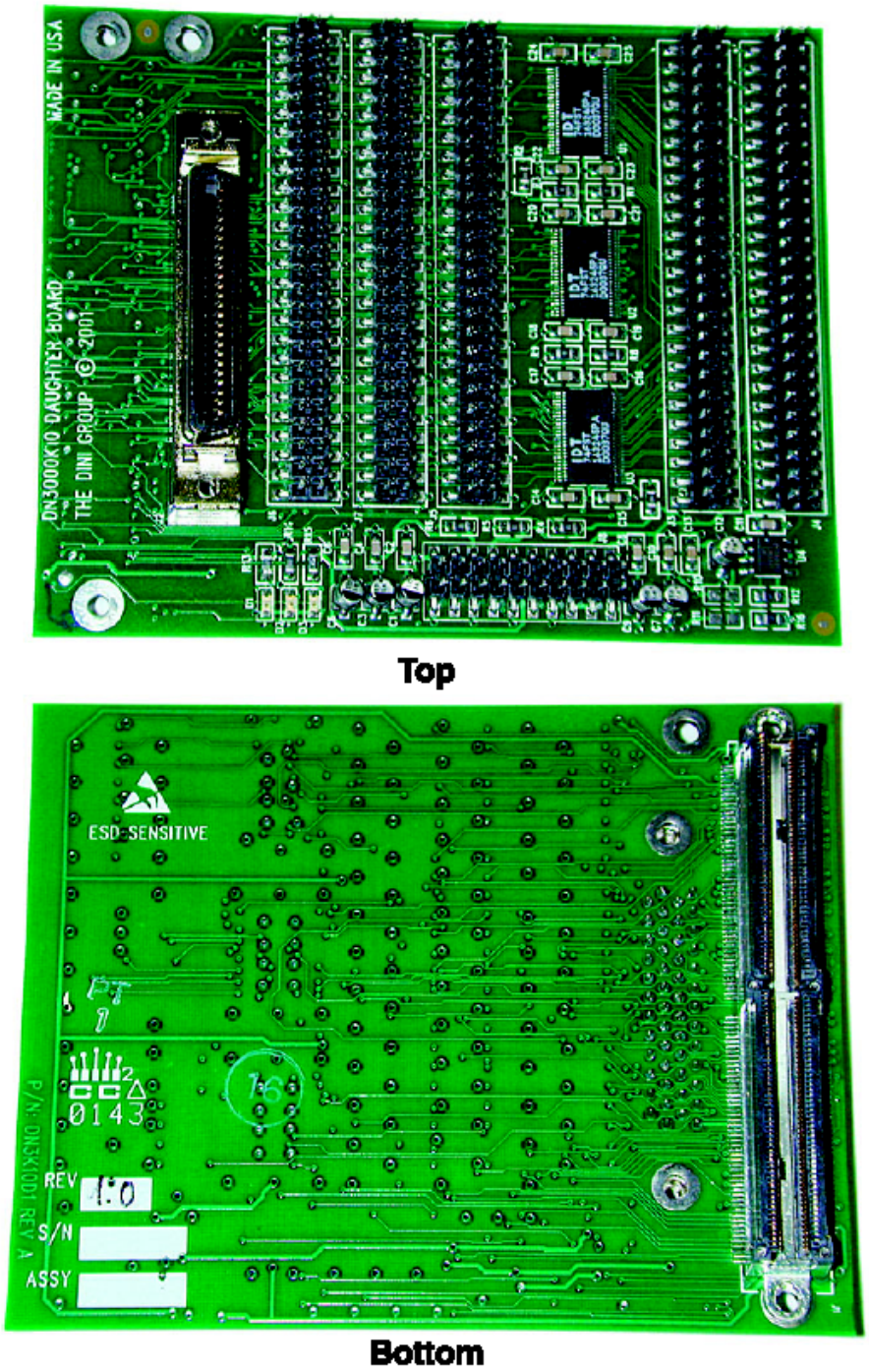


Figure 69 - ET3000K10S Daughter Card

Figure 70 show the assembly drawing of the ET3000K10SD Daughter Card. IDT74FST163245 devices (U1, U2, U3) are used as bus switches in the passive mode, and the IDT74LVC16245A (U1, U2, U3) devices are used as bus transceivers in the active mode. The ET3000K10SD has separate enable/direction signals for each driver.

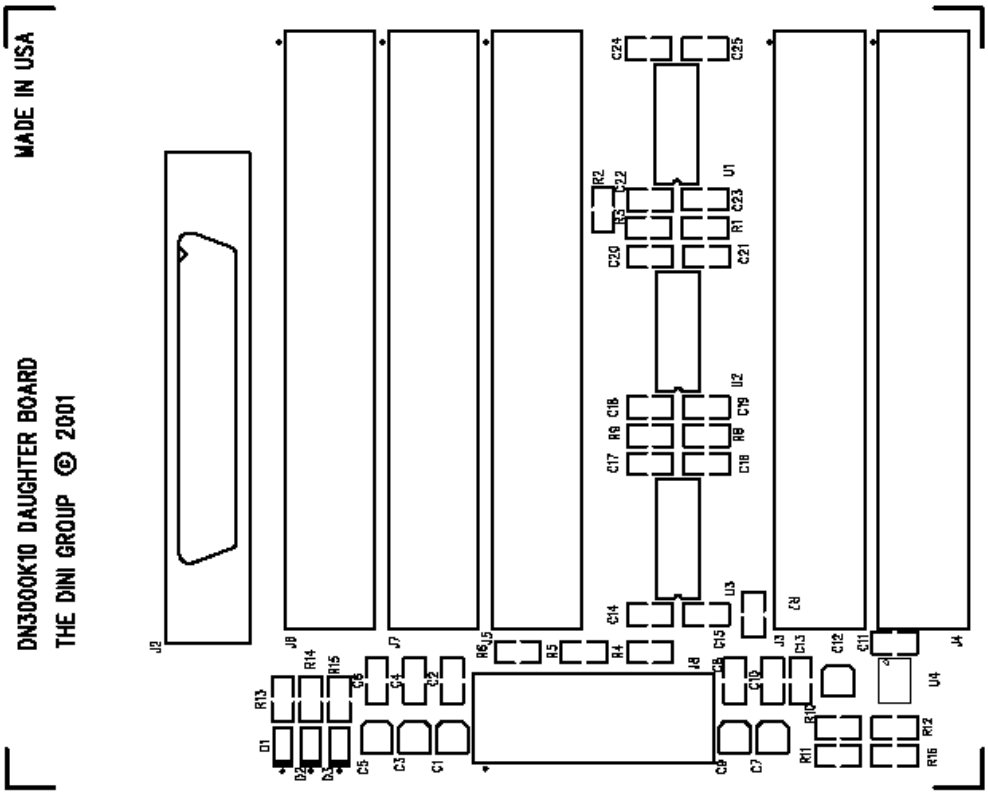


Figure 70 - Assembly drawing for the ET3000K10SD

NOTE: Signals P4NX7 and P4NX6 are also used for direction select and output enable on U2 and U3 respectively.

12.2.1 Daughter Card LED's

The LED's act as visual indicators, representing the presence of active power sources.

- D1 - LED indicating +3.3 V present
- D2 - LED indicating +5.0 V present
- D3 - LED indicating +12 V present

Under normal operating conditions, all LED's should be ON.

12.2.2 Power Supply

A linear power supply (U4) is present to provide level shift/translation functions when the board is populated with passive bus switches. Resistors R10 and R11 can be used to select alternate voltage sources, +5V or +3.3V, respectively. When used, U4 must be removed in order to prevent contention. The power supplies is rated as follows:

- +5 V power supply is rated for 1 A
- +3.3 V power supply is rated for 1 A
- +1.5 V power supply is rated for 1 A
- +12 V power supply is rated for 0.5 A
- –12 V power supply is rated for 0.5 A

NOTE: Never populate R10/R11 simultaneously, this will result in a shorting the +3.3V and +5V power supplies.

Header J8 allows external connection to the Power Sources (refer to Table 38 for connection details).

Table 38 - External Power Connections

Pin	Function	Pin	Function
J8.1	GND	J8.11	GND
J8.2	+5V	J8.12	+1.5V
J8.3	GND	J8.13	GND
J8.4	+5V	J8.14	+12V
J8.5	GND	J8.15	GND
J8.6	+3.3V	J8.16	+12V
J8.7	GND	J8.17	GND
J8.8	+3.3V	J8.18	-12V
J8.9	GND	J8.19	GND
J8.10	+1.5V	J8.20	-12V

12.2.3 Unbuffered IO

The ET3000k10SD Daughter Card provides 66-unbuffered I/O signals, including 5 single ended clock signals available on headers J5, J6, and J7. The function of these signals is position dependent.

12.2.4 Buffered IO

The ET3000k10SD Daughter Card provides 48-buffered I/O signals available on headers J3, and J4. The function of these signals is position dependent. U1, U2, and U3 allow for different populating options, and devices can be active or passive:

Active - The LCV162245A is used for asynchronous communication between data buses. It allows data transmission from the A to the B or from the B to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable (OE#) input can be used to disable the device so that the busses are effectively isolated

Passive - The FST163245 bus switches are used to connect or isolate two ports without providing any current sink or source capabilities. Thus, they generate little or no noise of their own while providing a low resistance path for an external driver. The output-enable (OE#) input can be used to disable the device so that the busses are effectively isolated.

12.2.5 LVDS IO

Low-voltage differential signaling (LVDS) is a signaling method used for high-speed transmission of binary data over copper. It is well recognized that the benefits of balanced data transmission begin to outweigh the costs over single-ended techniques when the signal transmission times approach 10 ns. This represents signaling rates of about 30 Mbps or clock rates of 60 MHz (in single-edge clocking systems) and above. LVDS is defined in the TIA/EIA-644 standards.

Connector J2 is a Mini D Ribbon (MDR) connector (50-pin) manufactured by 3M, used specifically for high speed LVDS signaling. The connector mates with a standard off-the-shelf 3M-cable assembly:

P/N 14150-EZBB-XXX-0LC

where XXX is: 050 = 0.5 m

150 = 1.5 m

300 = 3.0 m

500 = 5.0 m

Please contact 3M for further details: http://www.3m.com/

12.2.6 Connection between FPGA and the Daughter Card Headers

Table 39 shows the IO connections between the ET3000K10SD headers and the FPGA IO pins. The VCCO of the IO banks are connected to +2.5V.

Table 39 - Connection between FPGA and the Daughter Card Headers

Daughter Card Connections		ET6000K10S IO Connections			
Test Header	**Signal Name**	**Connector**	**Test Header**	**Signal Name**	**FPGA Pin**
J1.001	No Connect		P11.1	+12V	
J1.002	No Connect		P11.2	GND	
J1.003	ACLK1	J5.1	P11.3	+2.5V	
J1.004	No Connect		P11.4	+5V	
J1.005	BCLK1	J5.3	P11.5	+2.5V	
J1.006	No Connect		P11.6	+5V	
J1.007	CCLK1	J5.5	P11.7	CCLK1	
J1.008	No Connect		P11.8	GND	
J1.009	No Connect		P11.9	+3.3V	
J1.010	BP2N3(P2N3)	J3.1	P11.10	ECLK5	
J1.011	No Connect		P11.11	GND	
J1.012	BP2N2(P2N2)	J3.3	P11.12	TST_HDRA0	U15.M25
J1.013	P2N1	J2.8	P11.13	TST_HDRA1	U15.K26
J1.014	P2N0	J2.9	P11.14	TST_HDRA2	U15.AH42
J1.015	BP2NX7(P2NX7)	J3.5	P11.15	TST_HDRA3	U15.D26
J1.016	BP2NX6(P2NX6)	J3.7	P11.16	TST_HDRA4	U15.AH35
J1.017	BP2NX5(P2NX5)	J3.9	P11.17	TST_HDRA5	U15.M24
J1.018	BP2NX4(P2NX4)	J3.11	P11.18	TST_HDRA6	U15.AG35
J1.019	P2NX1	J2.10	P11.19	TST_HDRA7	U15.AG36
J1.020	P2NX0	J2.11	P11.20	TST_HDRA8	U15.AG38
J1.021	P3NX9	J2.40	P11.21	TST_HDRA9	U15.AG39
J1.022	No Connect		P11.22	GND	
J1.023	P3NX8	J2.41	P11.23	TST_HDRA10	U15.F34

Daughter Card Connections		ET6000K10S IO Connections			
Test Header	Signal Name	Connector	Test Header	Signal Name	FPGA Pin
J1.024	BP3NX5(P3NX5)	J3.13	P11.24	TST_HDRA11	U15.C34
J1.025	BP3NX4(P3NX4)	J3.15	P11.25	TST_HDRA12	U15.D33
J1.026	BP3N89(P3N89)	J3.17	P11.26	TST_HDRA13	U15.H32
J1.027	BP3N88(P3N88)	J3.19	P11.27	TST_HDRA14	U15.J32
J1.028	BP3N87(P3N87)	J3.21	P11.28	TST_HDRA15	U15.C33
J1.029	BP3N86(P3N86)	J3.23	P11.29	TST_HDRA16	U15.C32
J1.030	BP3N83(P3N83)	J3.25	P11.30	TST_HDRA17	U15.J31
J1.031	BP3N82(P3N82)	J3.27	P11.31	TST_HDRA18	U15.G31
J1.032	BP3N77(P3N77)	J3.29	P11.32	TST_HDRA19	U15.H30
J1.033	No Connect		P11.33	GND	
J1.034	BP3N76(P3N76)	J3.31	P11.34	TST_HDRA20	U15.C30
J1.035	BP3N75(P3N75)	J3.33	P11.35	TST_HDRA21	U15.C28
J1.036	BP3N74(P3N74)	J3.35	P11.36	TST_HDRA22	U15.C29
J1.037	P3N69	J2.42	P11.37	TST_HDRA23	U15.M14
J1.038	P3N68	J2.43	P11.38	TST_HDRA24	U15.C13
J1.039	BP3N67(P3N67)	J3.37	P11.39	TST_HDRA25	U15.L13
J1.040	BP3N66(P3N66)	J3.39	P11.40	TST_HDRA26	U15.L12
J1.041	BP3N63(P3N63)	J3.41	P11.41	TST_HDRA27	U15.C11
J1.042	BP3N62(P3N62)	J3.43	P11.42	TST_HDRA28	U15.C10
J1.043	BP3N57(P3N57)	J3.45	P11.43	TST_HDRA29	U15.C9
J1.044	No Connect		P11.44	GND	
J1.045	BP3N56(P3N56)	J3.47	P11.45	TST_HDRA30	U15.AG32
J1.046	No Connect		P11.46	TST_HDRA31	U15.AG33
J1.047	No Connect		P11.47	TST_HDRA32	U15.L20
J1.048	BP3N49(P3N49)	J4.1	P11.48	TST_HDRA33	U15.K20
J1.049	BP3N48(P3N48)	J4.3	P11.49	TST_HDRA34	U15.M20

Daughter Card Connections		ET6000K10S IO Connections			
Test Header	Signal Name	Connector	Test Header	Signal Name	FPGA Pin
J1.050	P3N47	J2.19	P11.50	TST_HDRA35	U15.M21
J1.051	P3N46	J2.20	P11.51	TST_HDRA36	U15.AK35
J1.052	BP3N43(P3N43)	J4.5	P11.52	TST_HDRA37	U15.G19
J1.053	BP3N42(P3N42)	J4.7	P11.53	TST_HDRA38	U15.AK36
J1.054	BP3N39(P3N39)	J4.9	P11.54	TST_HDRA39	U15.J19
J1.055	No Connect		P11.55	GND	
J1.056	BP3N38(P3N38)	J4.11	P11.56	TST_HDRA40	U15.M19
J1.057	BP3N35(P3N35)	J4.13	P11.57	TST_HDRA41	U15.L19
J1.058	BP3N34(P3N34)	J4.15	P11.58	TST_HDRA42	U15.C17
J1.059	BP3N29(P3N29)	J4.17	P11.59	TST_HDRA43	U15.C18
J1.060	BP3N28(P3N28)	J4.19	P11.60	TST_HDRA44	U15.E18
J1.061	BP3N27(P3N27)	J4.21	P11.61	TST_HDRA45	U15.AM33
J1.062	BP3N26(P3N26)	J4.23	P11.62	TST_HDRA46	U15.G18
J1.063	P3N23	J2.21	P11.63	TST_HDRA47	U15.L18
J1.064	P3N22	J2.22	P11.64	TST_HDRA48	U15.K18
J1.065	BP3N19(P3N19)	J4.25	P11.65	TST_HDRA49	U15.G17
J1.066	No Connect		P11.66	GND	
J1.067	BP3N18(P3N18)	J4.27	P11.67	TST_HDRA50	U15.AN34
J1.068	BP3N15(P3N15)	J4.29	P11.68	TST_HDRA51	U15.AF41
J1.069	BP3N14(P3N14)	J4.31	P11.69	TST_HDRA52	U15.L17
J1.070	P3N9	J2.23	P11.70	TST_HDRA53	U15.M17
J1.071	P3N8	J2.24	P11.71	TST_HDRA54	U15.M18
J1.072	BP3N7(P3N7)	J4.33	P11.72	TST_HDRA55	U15.F16
J1.073	BP3N6(P3N6)	J4.35	P11.73	TST_HDRA56	U15.E16
J1.074	BP3N3(P3N3)	J4.37	P11.74	TST_HDRA57	U15.H16
J1.075	BP3N2(P3N2)	J4.39	P11.75	TST_HDRA58	U15.C15

Daughter Card Connections		ET6000K10S IO Connections			
Test Header	Signal Name	Connector	Test Header	Signal Name	FPGA Pin
J1.076	BP4N27(P4N27)	J4.41	P11.76	TST_HDRA59	U15.C14
J1.077	No Connect		P11.77	GND	
J1.078	BP4N26(P4N26)	J4.43	P11.78	TST_HDRA60	U15.P12
J1.079	BP4N21(P4N21)	J4.45	P11.79	TST_HDRA61	U15.R12
J1.080	BP4N20(P4N20)	J4.47	P11.80	TST_HDRA62	U15.U5
J1.081	No Connect		P11.81	TST_HDRA63	U15.T12
J1.082	No Connect		P11.82	TST_HDRA64	U15.U12
J1.083	No Connect		P11.83	TST_HDRA65	U15.V12
J1.084	No Connect		P11.84	TST_HDRA66	U15.W12
J1.085	No Connect		P11.85	TST_HDRA67	U15.Y12
J1.086	No Connect		P11.86	TST_HDRA68	U15.AA12
J1.087	No Connect		P11.87	TST_HDRA69	U15.AB12
J1.088	No Connect		P11.88	GND	
J1.089	No Connect		P11.89	TST_HDRA70	U15.N12
J1.090	No Connect		P11.90	TST_HDRA71	U15.K5
J1.091	No Connect		P11.91	TST_HDRA72	U15.J5
J1.092	No Connect		P11.92	TST_HDRA73	U15.AK11
J1.093	No Connect		P11.93	+1.5V	
J1.094	No Connect		P11.94	TST_HDRA74	U15.AK12
J1.095	P4NX7	J7.45	P11.95	TST_HDRA75	U15.AK5
J1.096	P4NX6	J7.47	P11.96	TST_HDRA76	U15.AL12
J1.097	No Connect		P11.97	TST_HDRA77	U15.AU4
J1.098	No Connect		P11.98	TST_HDRA78	U15.AJ12
J1.099	No Connect		P11.99	GND	
J1.100	No Connect		P11.100	-12V	
J1.101	No Connect		P11.101	GND	

Daughter Card Connections		ET6000K10S IO Connections			
Test Header	Signal Name	Connector	Test Header	Signal Name	FPGA Pin
J1.102	MBCK1	J2.27	P11.102	TST_HDRA_CLKIN	U15.AP22
J1.103	No Connect		P11.103	+1.5V	
J1.104	MBCK0	J2.28	P11.104	GND	
J1.105	No Connect		P11.105	+3.3V	
J1.106	MBCK6	J5.9	P11.106	DCLK1	
J1.107	No Connect		P11.107	GND	
J1.108	ECLK1	J5.7	P11.108	GND	
J1.109	No Connect		P11.109	GND	
J1.110	No Connect		P11.110	GND	
J1.111	P2N5	J5.15	P11.111	TST_HDRA79	U15.AF12
J1.112	P2N4	J5.17	P11.112	TST_HDRA80	U15.AG12
J1.113	P2NX11	J2.2	P11.113	TST_HDRA81	U15.AE12
J1.114	P2NX10	J2.1	P11.114	TST_HDRA82	U15.AD6
J1.115	P2NX9	J5.19	P11.115	TST_HDRA83	U15.AD12
J1.116	P2NX8	J5.21	P11.116	TST_HDRA84	U15.AC6
J1.117	P2NX3	J5.23	P11.117	TST_HDRA85	U15.AC12
J1.118	No Connect		P11.118	GND	
J1.119	P2NX2	J5.25	P11.119	TST_HDRA86	U15.P33
J1.120	P3NX11	J2.29	P11.120	TST_HDRA87	U15.P34
J1.121	P3NX10	J2.30	P11.121	TST_HDRA88	U15.N31
J1.122	P3NX7	J2.31	P11.122	TST_HDRA89	U15.N32
J1.123	P3NX6	J2.32	P11.123	TST_HDRA90	U15.N41
J1.124	P3NX3	J5.27	P11.124	TST_HDRA91	U15.N42
J1.125	P3NX2	J5.29	P11.125	TST_HDRA92	U15.N39
J1.126	P3NX1	J5.31	P11.126	TST_HDRA93	U15.N40
J1.127	P3NX0	J5.33	P11.127	TST_HDRA94	U15.N33

Daughter Card Connections		ET6000K10S IO Connections			
Test Header	Signal Name	Connector	Test Header	Signal Name	FPGA Pin
J1.128	P3N85	J5.35	P11.128	TST_HDRA95	U15.N34
J1.129	No Connect		P11.129	GND	
J1.130	P3N84	J5.37	P11.130	TST_HDRA96	U15.N37
J1.131	P3N81	J5.39	P11.131	TST_HDRA97	U15.M35
J1.132	P3N80	J5.41	P11.132	TST_HDRA98	U15.AK39
J1.133	P3N79	J2.3	P11.133	TST_HDRA99	U15.AK40
J1.134	P3N78	J2.4	P11.134	TST_HDRA100	U15.L39
J1.135	P3N73	J2.6	P11.135	TST_HDRA101	U15.L38
J1.136	P3N72	J2.7	P11.136	TST_HDRA102	U15.L40
J1.137	P3N71	J2.33	P11.137	TST_HDRA103	U15.K40
J1.138	P3N70	J2.34	P11.138	TST_HDRA104	U15.L36
J1.139	P3N65	J5.43	P11.139	TST_HDRA105	U15.L37
J1.140	No Connect		P11.140	GND	
J1.141	P3N64	J5.45	P11.141	TST_HDRA106	U15.K42
J1.142	P3N61	J5.47	P11.142	TST_HDRA107	U15.J36
J1.143	P3N60	J5.49	P11.143	TST_HDRA108	U15.AK31
J1.144	P3N59	J6.1	P11.144	TST_HDRA109	U15.AK32
J1.145	P3N58	J6.3	P11.145	TST_HDRA110	U15.H37
J1.146	P3N53	J6.5	P11.146	TST_HDRA111	U15.D37
J1.147	P3N52	J6.7	P11.147	TST_HDRA112	U15.E37
J1.148	P3N51	J2.17	P11.148	TST_HDRA113	U15.D36
J1.149	P3N50	J2.18	P11.149	TST_HDRA114	U15.E36
J1.150	P3N45	J6.9	P11.150	TST_HDRA115	U15.P35
J1.151	No Connect		P11.151	GND	
J1.152	P3N44	J6.11	P11.152	TST_HDRA116	U15.P32
J1.153	P3N41	J6.13	P11.153	TST_HDRA117	U15.P31

Daughter Card Connections		ET6000K10S IO Connections			
Test Header	Signal Name	Connector	Test Header	Signal Name	FPGA Pin
J1.154	P3N40	J6.15	P11.154	TST_HDRA118	U15.P38
J1.155	P3N37	J6.17	P11.155	TST_HDRA119	U15.P37
J1.156	P3N36	J6.19	P11.156	TST_HDRA120	U15.R34
J1.157	P3N33	J6.21	P11.157	TST_HDRA121	U15.R33
J1.158	P3N32	J6.23	P11.158	TST_HDRA122	U15.R38
J1.159	P3N31	J2.44	P11.159	TST_HDRA123	U15.R37
J1.160	P3N30	J2.45	P11.160	TST_HDRA124	U15.R32
J1.161	P3N25	J6.25	P11.161	TST_HDRA125	U15.R31
J1.162	No Connect		P11.162	GND	
J1.163	P3N24	J6.27	P11.163	TST_HDRA126	U15.T35
J1.164	P3N21	J6.29	P11.164	TST_HDRA127	U15.R35
J1.165	P3N20	J6.31	P11.165	TST_HDRA128	U15.T40
J1.166	P3N17	J6.33	P11.166	TST_HDRA129	U15.T33
J1.167	P3N16	J6.35	P11.167	TST_HDRA130	U15.T32
J1.168	P3N13	J6.37	P11.168	TST_HDRA131	U15.U35
J1.169	P3N12	J6.39	P11.169	TST_HDRA132	U15.AK38
J1.170	P3N11	J2.47	P11.170	TST_HDRA133	U15.AK37
J1.171	P3N10	J2.48	P11.171	TST_HDRA134	U15.W36
J1.172	P3N5	J6.41	P11.172	TST_HDRA135	U15.W35
J1.173	No Connect		P11.173	GND	
J1.174	P3N4	J6.43	P11.174	TST_HDRA136	U15.AK34
J1.175	P3N1	J6.45	P11.175	TST_HDRA137	U15.AK33
J1.176	P3N0	J6.47	P11.176	TST_HDRA138	U15.AA36
J1.177	P4N25	J7.1	P11.177	TST_HDRA139	U15.AA31
J1.178	P4N24	J7.3	P11.178	TST_HDRA140	U15.AB31
J1.179	P4N23	J7.5	P11.179	TST_HDRA141	U15.AA40

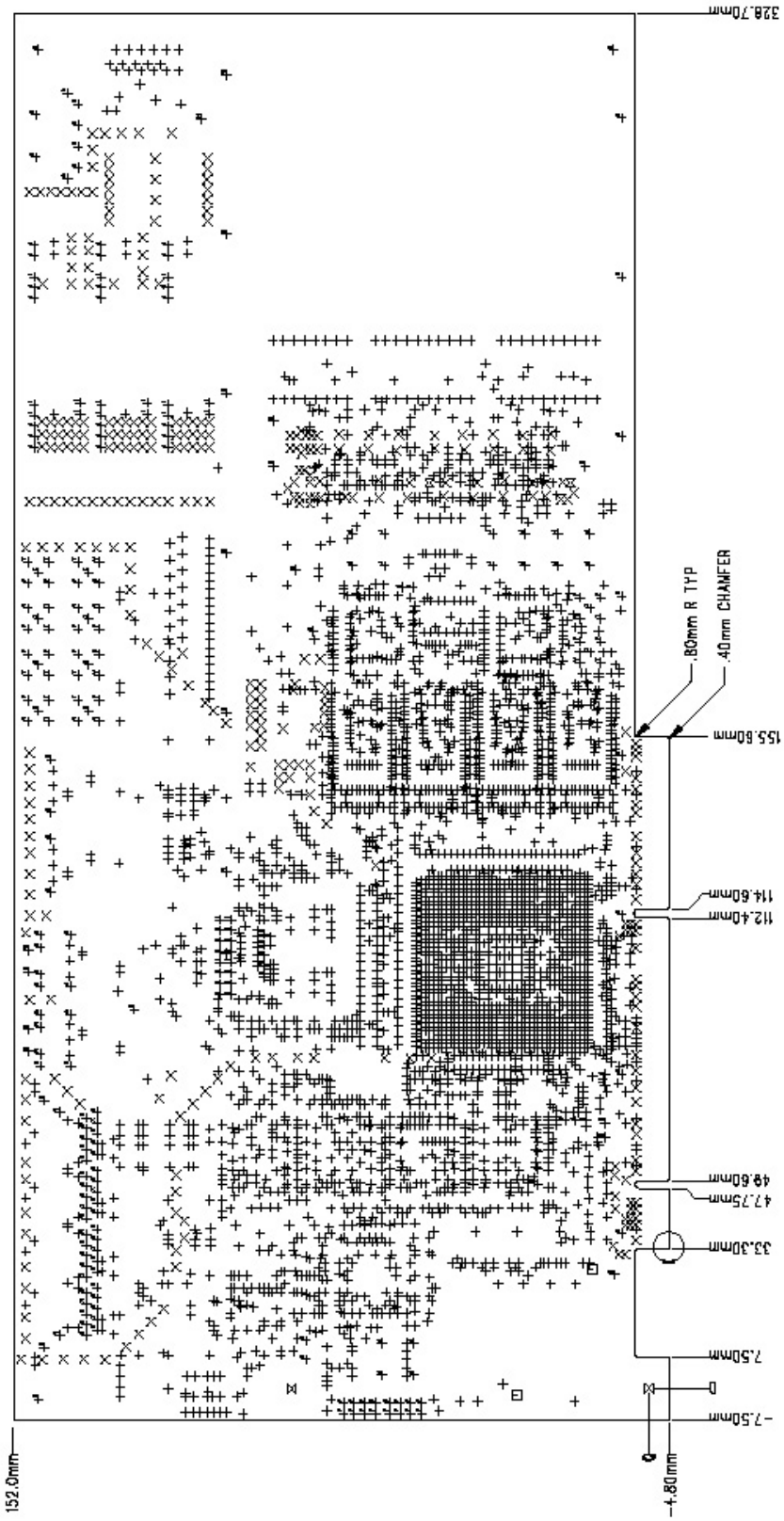
Daughter Card Connections		ET6000K10S IO Connections			
Test Header	Signal Name	Connector	Test Header	Signal Name	FPGA Pin
J1.180	P4N22	J7.7	P11.180	TST_HDRA142	U15.AA39
J1.181	P4N17	J7.9	P11.181	TST_HDRA143	U15.AJ35
J1.182	P4N16	J7.11	P11.182	TST_HDRA144	U15.AJ36
J1.183	P4N15	J7.13	P11.183	TST_HDRA145	U15.AJ33
J1.184	GND	J2.36	P11.184	GND	
J1.185	P4N14	J7.15	P11.185	TST_HDRA146	U15.AJ34
J1.186	P4N9	J7.17	P11.186	TST_HDRA147	U15.AJ37
J1.187	P4N8	J7.19	P11.187	TST_HDRA148	U15.AJ38
J1.188	P4N5	J7.21	P11.188	TST_HDRA149	U15.AJ41
J1.189	P4N4	J7.23	P11.189	TST_HDRA150	U15.AJ42
J1.190	P4N1	J7.25	P11.190	TST_HDRA151	U15.AJ31
J1.191	P4N0	J7.27	P11.191	TST_HDRA152	U15.AJ32
J1.192	P4NX13	J7.29	P11.192	TST_HDRA153	U15.AH33
J1.193	P4NX12	J7.31	P11.193	TST_HDRA154	U15.AH37
J1.194	P4NX9	J7.33	P11.194	TST_HDRA155	U15.AH38
J1.195	No Connect		P11.195	GND	
J1.196	P4NX8	J7.35	P11.196	TST_HDRA156	U15.AH31
J1.197	P4NX3	J7.37	P11.197	TST_HDRA157	U15.AH32
J1.198	P4NX2	J7.39	P11.198	TST_HDRA158	U15.AJ40
J1.199	P4NX1	J7.41	P11.199	TST_HDRA159	U15.AH40
J1.200	P4NX0	J7.43	P11.200	TST_HDRA160	U15.AH41

13 Mechanical

Two bus bars, MP2 and MP3 are installed to prevent flexing of the PWB. They are connected to the ground plane and can be used to ground test equipment. Be careful not to short any power rails or signals to these metal bars - they can carry a lot of

current. The PCI bracket (MP1) is also connected to the ground plane at each of the screw mounts. Mounting holes are provided for standalone operation.

The ET6000K10S conforms to the following dimensions:


328.70mm
.80mm R TYP
.40mm CHAMFER
155.60mm
114.60mm
112.40mm
49.60mm
47.75mm
33.30mm
7.50mm
-7.50mm
152.0mm
4.80mm

Chapter 7

Appendix

1 Appendix A: AETEST Installation Instructions

1.1 DOS and Windows 95/98/ME using DPMI

Precompiled executables, **aetestdj.exe** and **cwsdpmi.exe**, are included in the CD-ROM which is shipped with your ET6000K10S Logic Emulation board. If the user is running DOS on a Windows 95/98/ME machine, the PC must be booted using a DOS boot disk. A DOS boot disk is packaged with the ET6000K10S. The user only needs to follow the steps listed below to run the DPMI version of AETEST.

Follow the procedures listed below for installation:

1. Place the files **aetestdj.exe** and **cwsdpmi.exe** (The DOS Extender) into the same directory on your PC/machine.

2. Boot into DOS mode - if you have not already done so.

3. A DOS Boot disk must be used on the Windows machine.

4. Run **aetestdj.exe**.

1.2 Windows 98/ME using a VxD driver

Instead of running AETEST directly from DOS, the user can run AETEST with a VxD device driver. The driver file **PCICFG.VXD** and the executable **aetest98.exe** are included on the ET6000K10S' CD-ROM. The driver's source code and its makefile are also included.

Follow the procedures listed below for installation:

1. Place **PCICFG.VXD** and **aetest98.exe** into the same directory.

2. When Windows first starts with the device plugged in, it should ask for a device driver. Select "**Specify the location of the driver**".

3. Select "**Display a list of the drivers in a specific location…**".
4. Select "**Other devices**".
5. Under the "**Manufacturers**" tab, select "**unknown device**".
6. Under "**Models**", select "**unsupported device**".
7. Run **aetest98.exe**.

NOTE: To re-compile the driver file **PCICFG.VXD**, the user must download the VtoolsD compiler from http://www.numega.com/.

1.3 Windows 2000/XP

The precompiled executable **aetest_wdm.exe** and its source code are included in the ET6000K10S' CD-ROM. The driver file **DnDev.sys** and its corresponding inf file are also included in the CD-ROM.

Follow the procedures listed below for installation:

1. If the old version of AETEST's NT driver is installed on the machine, it must be uninstalled.
2. Start the PC with the ET6000K10S plugged – Windows should recognize the board and ask for a driver.
3. When the "**Found New Hardware Wizard**" box pops up, click "**Next**".
4. Select "**Display a list of the known drivers for this device so that I can choose a specific driver**".
5. Select "**Other device**".
6. Select "**Have Disk**".
7. Go to the directory where "**Dndev.inf**" is located and select it.
8. Locate the driver file "**DnDev.sys**".
9. Click on one of the devices and select "**Next**".
10. Run **aetest_wdm.exe**.

NOTE: To compile **aetest_wdm.exe**, the user must use Visual C++ 6.0. setupapi.lib in version 5.0 does not contain all of the necessary functions.

1.4 Windows NT

Precompiled executables, **aetestnt.exe** and **install.exe**, are included in the CD-ROM which is shipped with your ET6000K10S Logic Emulation board.

The driver files **QLDriver.sys** and **QLDriver_16MB.sys** are also included in the CD-ROM. The two driver files are identical except **QLDriver_16MB.sys** only allocates a maximum of 16MB per BAR. It is useful for systems with insufficient RAM. To use it, rename it to **QLDriver.sys** and re-install.

Follow the procedures listed below for installation:

1. Place the files **install.exe** and **QLDriver.sys** into the same directory on your PC/machine.

2. Type "**install**".

3. After the driver is installed, start the driver by selecting **Control Panel→Devices→**find "**QLDriver**"**→**click "**Start**"

4. Run **aetestnt.exe**.

Note: Although this driver will work under Windows 2000, we recommend using the WDM driver instead. If you must use it, see the README.txt file in the ../ntdriver/docs directory on the CD-ROM.

1.5 Linux

This version of AETEST has been tested on Red Hat Linux 7.2 (kernel version 2.4.x).

The driver file **dndev.o** and its source code are included in the ET6000K10S' CD-ROM. The scripts **dndev_load** and **dndev_unload**, which are also included in the CD-ROM, are used to load and unload the driver.

Follow the procedures listed below for installation:

1. Login as root to start the driver and run the program.

2. Load the driver; type "**sh dndev_load**".

3. Unload the driver; type "**sh dndev_unload**".

4. After the driver is loaded, run the utility **aetest_linux**.

5. The user may need to run chmod on **aetest_linux** to make it executable: type "**chmod u+x aetest_linux**".

NOTE: All text files including scripts are DOS text format (with an extra carriage return character after every new line), they must be converted.

1.6 Solaris

The utility and driver are tested on Solaris 7.0/Sparc with the 32-bit kernel.

Follow the procedures listed below for installation:

1. Login as root to install and run AETEST
2. Go to the driver directory, make sure the driver file "**dndev**" is in the sparc sub-directory.
3. To install the driver, run "**sh dndev_install.sh**".
4. To uninstall the driver, run "**sh dndev_uninstall.sh**".
5. Run **aetest_solaris**
6. The user may need to run chmod on **aetest_solaris** to make it executable: type "**chmod u+x aetest_solaris**".

The driver is compiled with the gcc compiler.

aetest_solaris is compiled with "gmake". You can download it from the GNU website. The "make" from the Solaris installation does not work with our makefile format.

NOTE: All text files, including scripts are DOS text format (with an extra carriage return character after every new line) they must be converted.

2 Appendix B: AETEST Basic C++ Functions

The AETEST utility program is built on a core of basic C++ functions. These functions perform a variety of PCI accesses (e.g. configuration reads/writes, memory read/writes) and test functions (e.g. memory tests). This appendix will describe a handful of these functions.

2.1 bar_write_byte

bar_write_byte is a high-level function C++ function which is recommended for development by users of the ET6000K10S.

2.1.1 Description

bar_write_byte allows users of the ET6000K10S to write a byte of data to any location in the Base Address Registers (BARs) of PCI memory. All 4 gigabytes of PCI memory is available for access.

2.1.2 Arguments

The arguments for **bar_write_byte** are shown in Table 40. They are listed in order.

Table 40: **bar_write_byte** Arguments

Argument	Description	Possible Values
unsigned long barnum	BAR number to be accessed	BAR0 = 0, BAR1 = 1, BAR2 = 2, BAR3 = 3, BAR4 = 4, or BAR5 = 5
unsigned long byte_offset	Address - Number of bytes to offset data	0x0 – bytes in BAR's mem. space
byte[1] data	A byte of data for the write operation (8 bits)	0x00 – 0xff

[1]typedef unsigned char byte;

2.1.3 Return Values

A successful function call will return zero.

2.1.4 Notes

The source code for **bar_write_byte** is portable to each of the operating systems intended for AETEST usage.

2.2 bar_write_word

bar_write_word is a high-level function C++ function which is recommended for development by users of the ET6000K10S.

2.2.1 Description

bar_write_word allows users of the ET6000K10S to write a word of data to any location in the Base Address Registers (BARs) of PCI memory. All 4 gigabytes of PCI memory is available for access.

2.2.2 Arguments

The arguments for **bar_write_word** are shown in Table 41. They are listed in order.

Table 41: **bar_write_word** Arguments

Argument	Description	Possible Values
unsigned long barnum	BAR number to be accessed	BAR0 = 0, BAR1 = 1, BAR2 = 2, BAR3 = 3, BAR4 = 4, or BAR5 = 5
unsigned long byte_offset	Address - Number of bytes to offset data	0x0 – bytes in BAR's mem. space
word[1] data	A word of data for the write operation (16 bits)	0x0000 – 0xffff

[1]typedef unsigned char word;

2.2.3 Return Values

A successful function call will return zero.

2.2.4 Notes

The source code for **bar_write_word** is portable to each of the operating systems intended for AETEST usage.

2.3 bar_write_dword

bar_write_dword is a high-level function C++ function which is recommended for development by users of the ET6000K10S.

2.3.1 Description

bar_write_dword allows users of the ET6000K10S to write a dword of data to any location in the Base Address Registers (BARs) of PCI memory. All 4 gigabytes of PCI memory is available for access.

2.3.2 Arguments

The arguments for **bar_write_dword** are shown in Table 42. They are listed in order.

Table 42: **bar_write_dword** Arguments

Argument	Description	Possible Values
unsigned long barnum	BAR number to be accessed	BAR0 = 0, BAR1 = 1, BAR2 = 2, BAR3 = 3, BAR4 = 4, or BAR5 = 5
unsigned long byte_offset	Address - Number of bytes to offset data	0x0 – bytes in BAR's mem. space
dword[1] data	A dword of data for the write operation (32 bits)	0x00000000 – 0xffffffff

[1]typedef unsigned char dword;

2.3.3 Return Values

A successful function call will return zero.

2.3.4 Notes

The source code for **bar_write_dword** is portable to each of the operating systems intended for AETEST usage.

2.4 bar_read_byte

bar_read_byte is a high-level function C++ function which is recommended for development by users of the ET6000K10S.

2.4.1 Description

bar_read_byte allows users of the ET6000K10S to read a byte of data from any location in the Base Address Registers (BARs) of PCI memory. All 4 gigabytes of PCI memory is available for access.

2.4.2 Arguments

The arguments for **bar_read_byte** are shown in Table 43. They are listed in order.

Table 43: **bar_read_byte** Arguments

Argument	Description	Possible Values
unsigned long barnum	BAR number to be accessed	BAR0 = 0, BAR1 = 1, BAR2 = 2, BAR3 = 3, BAR4 = 4, or BAR5 = 5
unsigned long byte_offset	Address - Number of bytes to offset data	0x0 – bytes in BAR's mem. space
byte*[1] data	Pointer to a byte of data for the read operation (8 bits)	0x00 – 0xff

[1]typedef unsigned char byte;

2.4.3 Return Values

A successful function call will return zero.

The byte of data read during the access is placed in the variable location pointed to by *data*.

2.4.4 Notes

The source code for **bar_read_byte** is portable to each of the operating systems intended for AETEST usage.

2.5 bar_read_word

bar_read_word is a high-level function C++ function which is recommended for development by users of the ET6000K10S.

2.5.1 Description

bar_read_word allows users of the ET6000K10S to read a word of data from any location in the Base Address Registers (BARs) of PCI memory. All 4 gigabytes of PCI memory is available for access.

2.5.2 Arguments

The arguments for **bar_read_word** are shown in Table 44. They are listed in order.

Table 44: **bar_read_word** Arguments

Argument	Description	Possible Values
unsigned long barnum	BAR number to be accessed	BAR0 = 0, BAR1 = 1, BAR2 = 2, BAR3 = 3, BAR4 = 4, or BAR5 = 5
unsigned long byte_offset	Address - Number of bytes to offset data	0x0 – bytes in BAR's mem. space
word*[1] data	Pointer to a word of data for the read operation (16 bits)	0x0000 – 0xffff

[1]typedef unsigned char word;

2.5.3 Return Values

A successful function call will return zero.

The word of data read during the access is placed in the variable location pointed to by *data*.

2.5.4 Notes

The source code for **bar_read_word** is portable to each of the operating systems intended for AETEST usage.

2.6 bar_read_dword

bar_read_dword is a high-level function C++ function which is recommended for development by users of the ET6000K10S.

2.6.1 Description

bar_read_dword allows users of the ET6000K10S to read a dword of data from any location in the Base Address Registers (BARs) of PCI memory. All 4 gigabytes of PCI memory is available for access.

2.6.2 Arguments

The arguments for **bar_read_dword** are shown in Table 45. They are listed in order.

Table 45: **bar_read_dword** Arguments

Argument	Description	Possible Values
unsigned long barnum	BAR number to be accessed	BAR0 = 0, BAR1 = 1, BAR2 = 2, BAR3 = 3, BAR4 = 4, or BAR5 = 5
unsigned long byte_offset	Address - Number of bytes to offset data	0x0 – bytes in BAR's mem. space
dword*[1] data	Pointer to a dword of data for the read operation (32 bits)	0x00000000 – 0xffffffff

[1]typedef unsigned char dword;

2.6.3 Return Values

A successful function call will return zero.

The dword of data read during the access is placed in the variable location pointed to by *data*.

2.6.4 Notes

The source code for **bar_read_dword** is portable to each of the operating systems intended for AETEST usage.

2.7 dma_buffer_allocate

dma_buffer_allocate is a high-level function C++ function which is recommended for development by users of the ET6000K10S.

2.7.1 Description

dma_buffer_allocate allows users of the ET6000K10S to allocate a DMA buffer.

2.7.2 Arguments

The arguments for **dma_buffer_allocate** are shown in Table 46. They are listed in order.

Table 46: **dma_buffer_allocate** Arguments

Argument	Description
dma_buffer_handle*[1] hndl	Pointer to a handle (int) for the allocated DMA buffer
int nbytes	Number of bytes of memory to allocate
int* phy_addr	Pointer to an int specifying the physical address of the DMA buffer

[1]typedef int dma_buffer_handle;

2.7.3 Return Values

A successful function call will return zero. An error will return a non-zero value. If -1 is returned, the allocation failed. If –2 is returned, the DPMI implementation of AETEST is not being used (See Notes).

An integer indicating the handle for the DMA buffer is placed in the variable location pointed to by *hndl*.

An integer indicating the physical address of the DMA buffer is placed in the variable location pointed to by *phy_addr*.

2.7.4 Notes

The **dma_buffer_allocate** code is written for use in the DPMI (DOS) implementation of AETEST.

2.8 dma_buffer_free

dma_buffer_free is a high-level function C++ function which is recommended for development by users of the ET6000K10S.

2.8.1 Description

dma_buffer_free allows users of the ET6000K10S to free memory associated with a previously allocated DMA buffer.

2.8.2 Arguments

The argument(s) for **dma_buffer_free** are shown in Table 47. They are listed in order.

Table 47: **dma_buffer_free** Arguments

Argument	Description
dma_buffer_handle[1] hndl	Handle for a DMA buffer

[1]typedef int dma_buffer_handle;

2.8.3 Return Values

A successful function call will return zero. If –2 is returned, the DPMI implementation of AETEST is not being used (See Notes).

2.8.4 Notes

The **dma_buffer_free** code is written for use in the DPMI (DOS) implementation of AETEST.

2.9 dma_write_dword

dma_write_dword is a high-level function C++ function which is recommended for development by users of the ET6000K10S.

2.9.1 Description

dma_write_dword allows users of the ET6000K10S to write a dword of data to any byte-aligned location in a DMA buffer.

2.9.2 Arguments

The arguments for **dma_write_dword** are shown in Table 48. They are listed in order.

Table 48: **dma_write_dword** Arguments

Argument	Description
dma_buffer_handle[1] hndl	Handle for a DMA buffer
int offset	Offset in bytes of the write location in the DMA buffer
dword[2] data	A dword (32 bit) of data for the write operation

[1]typedef int dma_buffer_handle;
[2]typedef unsigned char dword;

2.9.3 Return Values

A successful function call will return zero. If –2 is returned, the DPMI implementation of AETEST is not being used (See Notes).

2.9.4 Notes

The **dma_write_dword** code is written for use in the DPMI (DOS) implementation of AETEST.

2.10 dma_read_dword

dma_read_dword is a high-level function C++ function which is recommended for development by users of the ET6000K10S.

2.10.1 Description

dma_read_dword allows users of the ET6000K10S to read a dword of data from any byte-aligned location in a DMA buffer.

2.10.2 Arguments

The arguments for **dma_read_dword** are shown in Table 49. They are listed in order.

Table 49: **dma_read_dword** Arguments

Argument	Description
dma_buffer_handle[1] hndl	Handle for a DMA buffer
int offset	Offset in bytes of the write location in the DMA buffer
dword*[2] data	Pointer to a dword (32 bit) of data for the read operation

[1]typedef int dma_buffer_handle;
[2]typedef unsigned char dword;

2.10.3 Return Values

A successful function call will return zero. If –2 is returned, the DPMI implementation of AETEST is not being used (See Notes).

2.10.4 Notes

The **dma_read_dword** code is written for use in the DPMI (DOS) implementation of AETEST.

2.11 pci_rdwr

pci_rdwr is a function used in older revisions of AETEST. Users of the ET6000K10S are advised to use current functions such as bar_write_dword and bar_read_dword for development.

2.11.1 Description

pci_rdwr is the primary function for reading and writing to the Base Address Registers (BARs).

2.11.2 Arguments

The arguments for **pci_rdwr** are shown in Table 50. They are listed in order.

Table 50: **pci_rdwr** Arguments

Argument	Description	Possible Values
long barnum	BAR number to be accessed	BAR0 = 0, BAR1 = 1, BAR2 = 2, BAR3 = 3, BAR4 = 4, or BAR5 = 5
long byte_offset	Address - Number of bytes to offset data	0x0 – bytes in BAR's mem. space
long upper_data	The upper 32-bits of data for a 64-bit access	0x00000000 – 0xffffffff
long lower_data	Data (the lower 32-bits of a 64-bit access)	0x00000000 – 0xffffffff
int command	PCI command	MEM_READ (0x6) or MEM_WRITE (0x7)
int be	Byte Enables	0x00 - 0xff DWORD_BYTE_EN (0x0f)
int dwordcount	Number of DWORDs	1 or 2
int verify	Verify (TRUE) or do not verify access (FALSE)	0x0 – 0x1

2.11.3 ReturnValues

When **pci_rdwr** is called with 'MEM_READ' as its command argument, the returned DWORD is placed into the variable *access_memory_dword_read*. The declaration for *access_memory_dword_read* is:

```
Extern unsigned long access_memory_dword_read;
```

2.11.4 Notes

In a typical transaction, the **byte_offset** value will be a multiple of 4 resulting in a DWORD aligned read or write. The PCI command will either be a Memory Read or a Memory Write where MEM_READ and MEM_WRITE are #define definitions used in AETEST. BARx, where x = 0-5, are also #define definitions in AETEST. The byte enable **be** is often set to DWORD_BYTE_EN for 32-bit transactions. **dwordcount** is either 1 or 2 indicating a 32-bit or a 64-bit transaction respectively. Finally, the parameter **verify** is set to TRUE when the access is to be verified. If verification is not desired, **verify** is set to FALSE.

2.12 DeviceIoControl

DeviceIoControl is a low-level function. Users of the ET6000K10S are advised to use higher level functions such as bar_write_dword and bar_read_dword for development.

2.12.1 Description

DeviceIoControl is used to send commands and receive messages from a specified device on the PCI bus in a Windows environment. The QL library is based upon this function.

A successful **DeviceIoControl** operation will return zero. A non-zero value is returned if a failure occurs.

2.12.2 Arguments

The arguments for the **DeviceIoControl** method is listed in Table 51. They are listed in order.

Table 51: **DeviceIoControl** Arguments

Argument	Description
HANDLE hDevice	Handle to the device for operation
DWORD dwIoControlCode	Control code for the operation
LPVOID IpInBuffer	Pointer to a buffer containing data necessary for operation
DWORD nInBufferSize	Specifies the size, in bytes, of the buffer pointed to by IpInBuffer
LPVOID IpOutBuffer	Pointer to a buffer that receives the operation's output data
DWORD nOutBufferSize	Specifies the size, in bytes, of the buffer pointed to by IpOutBuffer
LPDWORD IpBytesReturned	Pointer to a variable that receives the size, in bytes, of the data stored into the buffer pointed to by IpOutBuffer
LPOVERLAPPED IpOverlapped	Pointer to an OVERLAPPED structure

2.12.3 Return Values

A successful **DeviceIoControl** operation will return zero. A non-zero value is returned if a failure occurs.

2.12.4 Notes

hDevice

The CreateFile function should be used to retrieve a handle.

dwIoControlCode

See include file qlcntlcodes.h, which is included with the AETEST source code, for example control codes.

IpInBuffer

This parameter can be set to NULL if no input data is required for the operation.

nInBufferSize

N/A

IpOutBuffer

This parameter can be set to NULL if operation does not produce any output data.

NOutBufferSize

N/A

IpBytesReturned

If the output buffer is too small, the call function fails and the returned byte count is zero. If the output buffer is full prior to operation completion, the call will fail. However, **DeviceIoControl** will return all of the data in the output buffer and returned byte count will correspond to the amount of data returned.

IpOverlapped

If hDevice was opened with the FILE_FLAG_OVERLAPPED flag, IpOverlapped must point to a valid OVERLAPPED structure. Under these conditions, the operation is asynchronous (i.e. an overlapped operation). If IpOverlapped is NULL under these conditions, the function will fail.

If the FILE_FLAG_OVERLAPPED was not used to open hDevice, IpOverlapped is ignored. The operation must complete before DeviceIoControl will return.

2.12.5 Derived Functions

The following functions are based on **DeviceIoControl**:

QL_ConfigRead, QL_ConfigWrite, QL_ControlRead, QL_ControlWrite, QL_BAR_Read, QL_BAR_Write, QL_MapBufferAddr, QL_UnMapBufferAddr, QL_GetBufferSize, QL_DMA_Read, QL_DMA_Write, QL_Map_BAR, QL_UnMap_BAR and QL_ResetDevice.